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THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Respecting the Official Work of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
SECRETARY'S OFFICE,
530 Broadway, N. Y., Dec. 13, 1904.

To the Members American Gas Light Association: As there seems to be some misunderstanding respecting the standing of the official management of the Association, members will please note that the undersigned is the Secretary of the Association, and that Mr. A. E. Forstall is carrying forward the work of the Practical Class. All correspondence in connection with the Practical Class should therefore be addressed to Mr. A. E. Forstall, 58 William street, and all other matter pertaining to the Association to MR. GEORGE G. RAMSDELL, Secretary, at the above address.

[OFFICIAL NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY,
DELAWARE, O., Nov. 21, 1904.

The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, General Manager of the Binghamton (N. Y) Gas Company, earnestly solicits the co-operation of the fraternity for contributions to be presented to the Twenty-first Annual Meeting of the Association, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

Editor Eysenbach will be pleased to receive contributions not later than February 10th. Work for the good of the cause and send him your "Wrinkles."

T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Bureau of Information, Ohio Gas Light Association.

CITY OF LINCOLN GAS CO.,
LINCOLN, ILLS., Oct. 10, 1904.

To the Fraternity: At the last meeting of the Ohio Gas Light Association a Bureau of Information was decided upon, the idea of which is to render assistance to members who may have questions coming up or difficultles arising respecting which they would like some help. This Bureau has been established and is now ready for business. A number of co-Editors have been appointed to whom the various questions will be referred. As this is the first Bureau of Information attempted by any Association, it is hoped that the members will take advantage of its opportunities. The co-Editors are as follows:

Distribution.—E. E. Eysenbach and M. E. Malone.
Accounts and Bookkeeping.—D. W. Low and Chas. Ritter.
New Business and Gas Appliances.—Frank D. Moses, Ralph Woodward and F. Cavanagh.
Chemistry.—H. B. Harrop and Clarence Lomax.
Retort House.—Moses Coombs.
Natural Gas.—W. H. Hammon and Geo. W. Barnes.

All questions should be addressed to the Editor, at Lincoln, Ills.

Very truly yours,
H. L. OLDS, Editor Inform[illegible]

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BRIEFLY TOLD.

DEATH OF MR. THOMAS H. BIRCH, SR.—With exceeding regret we have to chronicle the death of Mr. Thomas H. Birch, Sr., who passed away at his home in Carthage, O., the afternoon of the 18th inst. His death was all the more grievous in that it was altogether unlooked for, hardly any premonition of its approach having been manifested. The Stacey Manufacturing Company, of Cincinnati, O., in announcing to us the sad event, writes: "For 36 years he has faithfully served the interests of this Company, and we take this means of paying our respects to his memory as a man distinguished for a fine sense of honor, a strict regard for his obligations and a thorough consideration of the rights and feelings of others." This tribute is certainly of the sort that may not be gainsaid, for it was prepared by men with whom he had been associated for well over a third of a century in the closest of business ties and the nearest of personal relations.

DEATH OF MR. FRANK MURPHY.—Another death in the ranks we have to report is that of Mr. Frank Murphy, of Omaha, Neb., whose demise occurred in the Hotel Waldorf-Astoria, N. Y., early the morning of the 12th inst. Deceased, who was in his 64th year, having been born in Pittsburg, Pa., July 31, 1841, became a resident of Omaha in 1887, and there his life work was done, and so well done, from a goods' point of view, that at the time of his death his wealth was counted in the millions. He was interested in a great number of sound enterprises in and out of the State of Nebraska, and besides being President of the Omaha Gas Company for several years, was also one of its largest shareholders. Mr. Luther Drake, a prominent official in the Merchants National Bank of Kansas City, and who had been associated with Mr. Murphy in a business way for 25 years, speaking of the deceased, said: "I never knew a man who had a sounder business sense, and his judgment was sought in financial affairs by the best business men of the city. He was greatly loved by all who worked for him because of his kindness and consideration." We have received no mention respecting the funeral services.

NOTES——

THE lessees or proprietors of the Hartford (Conn.) City Gas Light Company have determined to, in the near future, extend their mains to the outlying district of East Hartford. It is likely the extension will be made early in the spring.

THE plant and franchises of the Vineland (N. J.) Gas Company have been purchased by Mr. Liddon Flick and associates, of Wilkes-Barre, Pa. The plant will be rebuilt.

THE reorganization of the El Paso (Tex.) Gas, Electric Light and Power Company has been completed. The title of the succeeding corporation is that of the El Paso Gas and Electric Company, and its executive management is: President, George F. Goodnow, Waukegan, Ills.; Vice-President and Treasurer, C. H. Bosworth, Chicago; Secretary, W. J. Cook, Chicago; Asst. Sec. and Treas., George D. Flory; Gen. Manager, Thomas J. Jones. A reduction of 50 cents per 1,000 in the gas selling rate was ordered, and it was also voted to expend $50,000 in plant betterment.

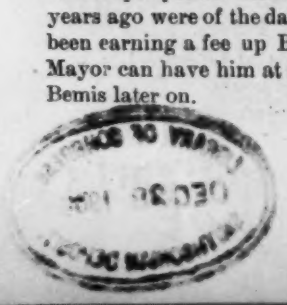
THE Pasadena (Cal.) Consolidated Gas Company informs us that after January 1st the selling (net) price for gas there will be 90 cents per 1,000 cubic feet. That's a pretty low figure for the district named.

THE final details in the taking over of the Huntington (L. I.) Gas Company by the Huntington Light and Power Company have been completed. Messrs. Street, Wykes & Co., of New York, no longer have any interest in the Company, the interests of which they managed wisely and well from the very construction of the plant.

THE Hon. Thomas Winship, at one time prominent in the affairs of the Citizens Gas Light Company, of Wakefield, Mass., died at his home in Wakefield the night of the 12th inst. Deceased was born in Wakefield (at the time the place was known as South Reading), October 14, 1826, and was widely and well known through central and western Massachusetts. His wife, a son and a daughter survive him.

THE capital stock of the Dayton (O.) Gas Light and Coke Company is to be increased to a total of $1,000,000.

GAS men who are of the order rational, thought that Prof. Bemis, whose peripatetic stands against the "gas system" legitimate some years ago were of the daily and nightly order, was dead. He isn't; he's been earning a fee up Boston-way with Boston's Mayor lately. The Mayor can have him at so much per day. Lawson might like to hire Bemis later on.



Gas Leakage.[1]

By MR. F. S. CRIPPS.

It is of the utmost importance that all who have to do with the management of gas apparatus, should appreciate the enormous loss of gas which may take place through a very small hole—such, for instance as that left by a rivet falling out of a joint in a gasholder sheeting. The object of this communication is to give easy rules, followed by a table, indicating the quantity of gas which can escape through small holes direct into the atmosphere. When once this is appreciated, it will be seen how essential it is that all above ground apparatus, particularly gasholders, should be periodically examined for leaks. We hear so much about "unaccounted-for" gas, but it is to be feared we do not always look in the most likely places to find it.

The quantity of gas escaping from a leak in an underground gas main is not so serious as that from a similar sized leak above ground where it has free access into the open air. The ground offers considerable frictional resistance to the flow of gas in the former case, depending entirely on the closeness with which the main is muffled by it. It is therefore impossible to give any hard and fast rules for leaks in underground mains, where the gas cannot get away freely. Hence, the rules and tables which follow apply only to leaks in the open air. By the exercise of judgment they may be serviceable in determining roughly the loss from underground leakage; but this is not their primary use.

The general formula for the escape of gas through an orfice is—

$$V=\sqrt{\frac{2gp}{12}\times\frac{773.2}{s}\times(1+at)\times\frac{29.92}{h}}\ ^{2}$$

Where V = velocity of discharge in feet per second.
$2g$ = 64.4.
p = pressure of gas (in inches of water) in the vessel from which gas is escaping—*i.e.*, the difference in pressure outside and inside.
773.2 = volume of air at 32° F. under pressure of 29.92 inches.
s = specific gravity of gas, taking air as 1.
t = temperature.
h = barometric pressure in inches of mercury.

Filling in these values, and assuming $s = 0.44$; $t = 62°$ F., and $h = 29.92$, we have—

$$V=\sqrt{\frac{64.4\,p\times 773.2\times 29.92}{12\times 0.44\times 29.92}\times\left(1+\frac{t-32}{493}\right)}$$

That is—

$$V=\sqrt{\frac{5.37+1,755\times 523}{493}\times p}\text{ or }99.9\sqrt{p},$$

which for all practical purposes we may write in the very simple form—

$$V=110\sqrt{p}.$$

The highly complicated formula with which we started has, therefore, been condensed into a very simple rule—viz., the *velocity* is equal to 100 *times the square root of the pressure.*

But the velocity is affected by the shape of the orifice, and, therefore, it becomes necessary to multiply the above formula by a constant, depending upon the kind of opening. For a circular opening in thin plate, such as we are considering, we find that the constant varies (according to Welsbach) from 0.56 to 0.79. Taking it as 0.61, we have—

$$V=100\times .61\times\sqrt{p}.$$

Now, given the velocity of the escaping gas, we can easily determine the quantity of gas which will be discharged. We have simply to multiply the velocity by the area of the opensng in square feet, or—

$$\frac{d^2\times .7854}{144}$$

when d = diameter of hole. The formula then becomes—

$$Q=\frac{100\times 0.61\times\sqrt{p}\times d^2\times 0.7854}{144}$$

where Q = quantity of gas discharged in cubic feet per *second.*

It is, however, more convenient to have the quantity per hour or per quarter, as the loss is then more apparent and appeals to us with greater force. If, then, we multiply by 3,600 (the number of seconds in 1 hour), and reducing, we have—

$$Q_1=1,197.7\sqrt{p}\times d^2$$

which for all practical purposes we may write—

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1. *Journal of Gas Lighting.*
2. For verification of the general formula see D. Kinnear Clarke's "Rules and Tables."

$$Q_1 = 1{,}200\sqrt{p} \times d^2$$

This is the practical formula we have been seeking, and it may be written in words thus: To find the quantity of gas (in cubic feet) which can escape per hour from a circular hole in a thin plate, *multiply the square root of the pressure by the square of the diameter of the hole (in inches) and by* 1,200.

To give it a practical application, we will suppose that a rivet has dropped out of the top sheeting of a gasholder, leaving a hole ¼ inch diameter, and that the pressure of gas in the holder is 8 inches. It is required to know how much gas escapes per hour. Filling the values in the formula, we have—

$$Q_1 = 1{,}200 \times \sqrt{8} \times 0.25^2$$

or

$$1{,}200 \times 2.83 \times 0.0625 = 212.$$

That is, gas would escape at the rate of 212 cubic feet per hour; and, as there are about 2,190 hours ina quarter, the total leakage from the ¼-inch rivet hole would (unless stopped) amount to no less than 464,280 cubic feet, or nearly *half a million cubic feet* per quarter!

Little more need be said; but to still further emphasize the importance of paying attention to what some might otherwise think trivial matters, a table follows giving the loss under various gas pressures from holes of different sizes, per *hour* and per *quarter*. It will be seen that the holes vary from 1-16th of an inch up to 3 inches in diameter, and the pressure from 2 inches up to 25 inches of water pressure. A study of this table should convince the most careless of the importance of attending to leaks.

Leakage of Gas Under Pressure, Through Round Holes in Thin Plates.

Pressures in Inches of Water.	Leakage in Cubic Feet per Hour Through a Hole.								
	1/16-Inch Diameter.	1/8-Inch Diameter.	¼-Inch Diameter.	½-Inch Diameter	¾-Inch Diameter.	1-Inch Diameter.	1½-Inch Diameter.	2 Inches Diameter.	3 Inches Diameter.
2	6	26	106	424	954	1,697	3,818	6,788	15,273
4	9	37	150	600	1,350	2,400	5,400	9,600	21,600
6	11	46	183	735	1,653	2,939	6,613	11,757	26,454
9	14	56	225	900	2,025	3,600	8,100	14,400	32,400
12	16	65	260	1,039	2,338	4,157	9,353	16,627	37,412
16	19	75	300	1,200	2,700	4,800	10,800	19,200	43,200
25	23	94	375	1,500	3,375	6,000	13,500	24,000	54,000
Pressures.	**Leakage in Cubic Feet per Quarter. (Holes as Above)**								
2	14,510	58,070	232,280	929,130	2,090,540	3,716,550	8,362,160	14,866,200	33,448,650
4	20,530	82,120	328,500	1,314,000	2,956,500	5,256,000	11,826,000	21,024,000	47,304,000
6	25,140	100,580	402,300	1,609,300	3,621,000	6,437,000	14,484,000	25,749,000	57,936,000
9	30,800	123,200	492,700	1,971,000	4,435,000	7,884,000	17,739,000	31,536,000	70,956,000
12	35,600	142,400	569,700	2,279,000	5,127,000	9,114,000	20,507,000	36,457,000	82,027,000
16	41,060	164,200	657,000	2,628,000	5,913,000	10,512,000	23,652,000	42,048,000	94,608,000
25	51,300	205,300	821,000	3,285,000	7,391,000	13.140,000	29,565,000	52,560,000	118,260,000

Notes on Tables.

This table may be extended indefinitely (either way) by remembering that the *quantity* of gas passing *varies as the square roots of the pressures*, and also as the *squares of the diameters of the holes.*

In this way, it would be serviceable when determining the gas way in different parts of apparatus; the allowable frictional resistance being represented by the pressure taken either directly or indirectly from the table, the areas of gas ways being similarly determined.

At the best, such tables are only approximately correct, as the passage of gas is liable to so many disturbing influences. Hence, fractions of a cubic foot are omitted in the upper half, and the quantities are given in round numbers in the lower half of the table.

Of course, no leakage from the larger holes given would be likely to continue for 3 months without being found out; but the quantities have been stated for all sizes mentioned in the upper half of the table, to make it complete.

The Technical Analysis of Cements[1]

By Mr. S. F. Peckham.

The recent publication of the paper, by Mr Bertram Blount, on "The Analysis of Portland Cement," agains brings to the attention of chemists this important question that has been allowed to slumber for some months.

The very satisfactory results and conclusions reached by Mr. Blount, with which I almost wholly agree, led me to a reperusal of the papers read by Dr. Hillebrand, and to a reconsideration of the subject. The practical value of the conclusions reached by Mr. Blount cannot be overestimated, and I say this without any intention of understimating the intrinsic value of all the work done by Dr. Hillebrand, and Mr. Richardson's committee. Whether or no it is desirable to formulate a process of analysis that all chemists may be expected to follow, the direct results that have followed the work of this committee and the discussion that has proceeded from it, have proved to be of such value as to wholly justify all that has been done by all the parties concerned.

I think, however, that in the presentation up to this date, several very important aspects of the general subject have been lost sight of or overlooked. The discussion has proceeded as if there was little or no variation in the quality of cements, also as if there was one invariable purpose in the analysis of cements, and further, the analysis of the slurry and other substances used in the manufacture of cement has been mixed up with the analysis of cements, as if the sole object of the committee had been to devise the best scheme for the anaylsis of a uniform material for a uniform purpose.

Now I think it is quite clear that the problems presented to a chemist in a cement manufactory, and the problems presented in a city laboratory, and the problems presented to Dr. Hillebrand, are wholly different and require for their solution consideration of wholly different methods of procedure. The problems presented to Dr. Hillebrand were wholly scientific and have been treated by him in a manner that leaves nothing to be desired. If I understood him correctly, in a conversation he said that the technical aspects of the subject had not been presented to him and had not been considered by him. Such a conclusion is to be reached from a perusal of his papers. A further conclusion is to be reached by their perusal, *viz.*, that such methods of manipulation as he recommends, intrinsically valuable as they are, can be used to very little purpose by the class of manipulators that he describes.

It is to be presumed that a majority of these men who work with dirty water and impure reagents have passed scores of examinations sucessfully, and have worked up with the aid of their instructors, a thesis for a doctor's degree, cramming themselves full of information about things without the slightest appreciation of the temperamental and physchological qualities essential to the solution of chemical problems. I once remarked to a young professor of chemistry that a successful chemist must be a creator. He stared at me in open-eyed wonder and asked me where I could find one. What more striking demonstration could be found of the truth of Sir William Ramsay's strictures on technical education, that present methods develop memory and leave the inventive faculties dormant; that they show only what a man knows and not at all what he can do.

To return to our subject, it seems to me that while the strictly scientific aspects of the subject have been discussed in a masterly and well nigh exhaustive manner, resulting in the presentation of a large amount of analytic data of the greatest value, the questions have been left wholly undetermined whether or not ultimate methods of analysis are to be applied indiscriminately to the solution of the three classes of

1. *Journ. Am. Chem. Soc.*

problems mentioned above; or, if proximate methods are preferable, in what cases are they preferable?

Those engaged in the manufacture of cement can best decide what method of analysis will best solve the problems presented to them.

So, too, those who use cement and those who control the use of cement can best decide what methods are best suited to the time, place, conditions and identity of the problems presented to them for solution. For illustration: In a laboratory where determinations of lime are of daily occurrence, the use of premanganate solution may be both convenient and expeditious,; but in a laboratory where the work is very varied and the aggregate of lime determinations does not occupy more than 6 weeks in a year. more time is lost in adjusting the permanganate solution than is saved by its use. There are a multitude of reasons, too numerous to mention, why the judgment of Mr. Blount is sound, that each chemist should be left free to decide for himself what analytical methods he will use, for if the analyst is not capable of making this decision, he is like a general in the field, subject to the dictations of a bureau.

Instead of having a number of uniform problems presented to this laboratory relating to cements, scarcely two of them have been exactly alike. To treat them uniformly by the most elaborate method of ultimate analysis, even as faultlessly arranged as that of Dr. Hillebrand, with determinations of tintanium and phosphates, carried to a thousandth of a per cent., and with silica twice evaporated, and all the other refinements, would be a waste of time to little or no purpose. First-class cements containing a minimum of insoluble matter are rarely brought to this laboratory. The first determination I make is for "matter volatile at a red heat." For this purpose we, some time ago, installed an electrical muffle that with a current of given intensity, controlled by a rheostat, gives a uniform low red heat. Using 2 half ounce platinum crucibles, duplicate determinations can be made with great accuracy.

I then weigh out 5 grams of the cement, just as it is received. To dry or pulverize it would make another and different sample of it. I use 5 grams instead of 0.5 gram for the reason that I have found, by considerable experience with students that the number of human beings who are endowed by nature with the capacity to manipulate successfully and accurately very minute quantities, is, as a rule, very small. If 5 grams were taken, on an average there will be left enough insoluble residue for examination by fusion if desired. True, there is more silica dissolved on an average than is neccessary; but, generally, when a reasonably large amount is taken, the errors are compensated by a smaller proportional personal equation and smaller loss. All of the *cement* is decomposed by 10 per cent. hydrochloric acid. If the solution is made slowly and with care, no soluble silica is rendered insoluble; hence there is no need of the use of sodium carbonate. No process for the manufacture of cement is practically perfect, hence a small percentage of overburned or underburned slurry is to be expected in an average sample of even the best cement, along with an always present percentage of the ash of the coal that is blown into the rotary kiln. None of this material is cement and no method of analysis should be used, such as the use of strong acid that will decompose the ash, or of sodium carbonate that may dissolve part of the silica that is not in combination as cement, and thereby increase the percentage of silica apparently present as a constituent of the cement. While in this particular I do not agree with Mr. Blount, I do not question his conclusions concerning coarse cements that dissolve slowly. The solution cannot be hurried. A great deal of work has been done in this laboratory upon several hundred samples of cements of very differing quality. In no case, that has been tested, has any lime been found in the residue from 10 per cent. hydrochloric acid. An attempt was made to secure an acid that would decompose calcium carbonate and leave the cement intact, but wholly without success. Organic acids that were strong enough to decompose carbonates invariably decomposed the cement and sometimes rendered the silica insoluble.

Applied to several hundred problems, now for several years, the method that I recommend for bringing the silica that forms a part of the cement into solution, has been found to be wholly satisfactory for technical purposes. I, therefore, insist that it is neither "puzzolanic material" nor ashes that should be decomposed, but cement. When Mr. Blount admits that by the use of either supplementary grinding or strong acid, other silica than that constituting cement is brought into solution along with that contained in the cement, he yields all that for which I have been so long contending and which Dr. Hillebrand recommends. I evaporate the silica solution over night over a water bath heated by an electrical stove. Morning usually finds the residue dry at a temperature below the boiling point of water. Heating to a temperature of about 250° F., on an electrical stove, completes the dehydration at a uniform and low temperature. I am not prepared to say that small quantities of silica do not remain in solution on a single evaporation, but for technical purposes it is a negligible proportion of that contained in 5 grams.

The filtrate from the silica is made up to a liter and 2 portions, of 100 cc. each, are measured into 2 Becher glasses. The average technical analyst has no time to redistil ammonium hydroxide. It is much more economical of time to assume a contamination with ammonium carbonate and reprecipitate. This is not a long operation, especially with a filter pump, and is *always* safe. For technical purposes the lime and magnesia are easily determined with one precipitation each, although each may be contaminated with a trace of the other.

It is rare that for technical purposes a determination of carbon dioxide or alkalies is necessary.

While thanking Dr. Hillebrand and Mr. Blount for all the good things they have said and done, I am confident that the scheme above set forth will be found to furnish all the information necessary for the solution of a great number of technical problems, for which the elaborate niceties of Dr. Hillebrand's scheme were never intended, and for which they should never be recommended.

How to Safely Expel Air from Gas Apparatus, Mains and Holders.

By Mr. E. C. Jones, in "The Purifyer."

It often becomes the duty of those in charge of gas works to expel the air from new pieces of apparatus, from gasholders and from new installations of street mains. This, in the vernacular of the gas man, is called "purging," and the writer has been unable to find any safe rule to accomplish the expulsion of the air, laid down in any books on the subject of gas manufacture.

It is customary in the starting of gas works to blow out the air through an opening at a point farthest from where the gas is admitted, and the air is allowed to escape until it has a strong odor of gas, when it is taken for granted that the air has been displaced by gas. Sometimes a test is made by lighting the gas through a burner containing a piece of wire gauze, and the fact that the explosive limits of mixtures of gas and air are within so narrow a range has prevented many serious accidents. It is hard to say whether the lighting of gas at such times is due to bravery or ignorance, but if it is due to the former it usually menaces the property of others than the man with the match.

The use of wire gauze for preventing the passage of flame is dependent upon as many conditions that it may be safely said it is never without danger, and although this safeguard is based on the well known Davy miners' safety lamp, no dependence should be placed upon it without absolute knowledge of the composition of the gaseous mixture and air, its ignition temperature, flame temperature, the degree of fineness of the wire gauze and its strength.

It will be readily seen that it is next to impossible to determine all of these conditions, and it is well known that slight changes in the conditions will cause the same mixture of gas and air, which may theoretically be safely lighted through a No. 16 gauze, to explode through a No. 100 gauze.

The writer has successfully used a simple and positive means of determining the amount when all of the air is expelled from any piece of apparatus by means of samples of the gaseous mixture taken out of the apparatus as the air is being expelled and tested at a safe distance.

All that is necessary to perform this experiment is an ordinary wooden bucket filled with soap suds. The soap suds may be made by first filling the bucket with hot water and whittling into it a bar of common soap. In connection with this bucket of common soap suds, a small rubber gas bag, such as is used for stopping 6-inch or 8-inch mains, is used for collecting the samples of gas.

Suppose it is desired to expel the air from a long stretch of large gas mains, a good sized pipe should be brought to a point 5 or 6 feet above the surface of the ground. At the top of this pipe it should have a funnel covered with fine wire gauze, carefully soldered around the edge. The size of the funnel is dependent upon the fineness of the wire gauze, and the enlargement is for the purpose of not contracting the area of the blow-off pipe. In this upright pipe there should be a damper, operated by an iron handle, similar to the damper used in stove pipes. This damper may be made of stiff cardboard. Below the damper there should be an ordinary petcock. These being provided, the gas is turned into the main and the damper in the blow-off pipe is opened, allowing

the air to pass out through the wire gauze. When it is desired to make a test, the damper is closed and the rubber attached to the pet cock, thus obtaining a sample of the mixture obtained in the main. This sample is then taken to some distance from the point where the air is being blown out, and the rubber tubing attached to the rubber bag is placed in the bucket of soap suds. By squeezing the rubber bag the air, or gas and air, is forced through the soap suds, forming large bubbles on the surface. Light a match and ignite the bubbles, taking care that flame does not reach the gas in the rubber bag.

These experiments are interesting as they proceed. First, the air in the bubbles will extinguish the match; then, as the gas becomes mixed with air in the pipe, the bubbles will explode with a loud report. After the danger point has been passed, the gas in the bubbles will burn, and finally, when all the air has been expelled, the gas in the bubbles will slowly burn with a brilliant flame; so that, besides knowing that all the air has been expelled, the quality of the gas in the main may be determined according to the judgment of the experimenter.

After the air has been expelled, it is simply necessary to remove the blow-off pipe and plug the opening. This is accomplished after closing the valve which originally admitted the gas into the new main.

The application of this method of expelling air from new gasholders is made extremely simple, safe and quick by making a blow-off pipe of tin or galvanized iron with a flange of the same material. This blow-off pipe is made as large as is permitted to pass through the manhole in the crown of the holder, and the pipe should extend down to within a few inches of the surface of the water in the holder tank, and the pipe may be suspended by a flange of the same material soldered on at a point where it will rest on the crown of the holder and hold the pipe in place in the manhole. This pipe should extend upwards to a point above the head of a man and should be flared out into a funnel, on which is carefully soldered a sheet of fine wire gauze. A butterfly valve, made of paste or millboard, as previously described, is provided, and a petcock is placed below the valve. When the gas is turned into the holder, it rises to the crown and the air is forced downward and up through the blow-off pipe from a point near the surface of the water. It is surprising how quickly the air may be expelled without becoming mixed with gas. The writer has made tests within 10 minutes of each other in blowing out the air from a 2,000,000-foot gasholder, where the first test showed no trace of gas, the second burned with a faint yellow flame, and the third burned brightly, showing no presence of air. This work was done so quickly and well that at no time was it possible to obtain a sample of explosive mixture of gas and air.

In starting up new pieces of apparatus in old gas works it will be found safe and convenient to blow out the apparatus backward with gas already made, rather than to depend upon new generating sets to displace the gas in the condensers, scrubbers and purifiers. Many explosions have been avoided in this way.

Following is a table showing the air required for the complete combustion of various gases:

Heavy hydrocarbons—$C_2H_4 + 3O_2 = 2CO_2 + 2H_2O$.

One volume requires 14.28 volumes air or 3 volumes oxygen.

Carbonic oxide—$2CO_2 + O_2 = 2CO_2$.

One volume requires 2.38 volumes air or ½ volume oxygen.

Hydrogen—$2H_2 + O_2 = 2H_2O$.

One volume requires 2.38 volumes air or ½ volume oxygen.

Marsh gas (methane)—$CH_4 + 2O_2 = CO_2 + 2H_2O$.

One volume requires 9.52 volumes of air or 2 volumes oxygen.

The danger point with coal gas begins at 7 per cent. of gas mixed with 93 per cent. of air, and ceases when the mixture contains 23 per cent. of gas and 77 per cent. of air. The range of explosibility in water gas is between 7½ per cent. of gas and 92½ per cent. of air and 26 per cent. of gas and 74 per cent. of air. Below the minimum amount of gas the mixture will not burn, and above the maximum amount of gas the mixture will not explode, but will burn freely.

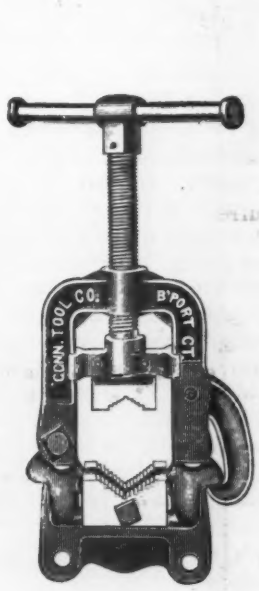
Following are ignition temperatures, according to Messieurs Mallard and Le Chatelier: Hydrogen, with necessary portion of air, ignites at 1,020° F., and different mixtures of hydrogen and oxygen and hydrogen and air ignite at various points between 985° and 1,100° F. All the different mixtures of carbonic oxide and oxygen or air ignite between 1,110° and 1,220° F.

The writer hopes that the above simple way of finding out when all the air is expelled from gas apparatus with perfect safety will afford the comfort and peace of mind which comes with positive knowledge (and can never be obtained by guessing), will save your company gas, give assurance of the safety of your company's property, and avoid your own worry and nerve wear.

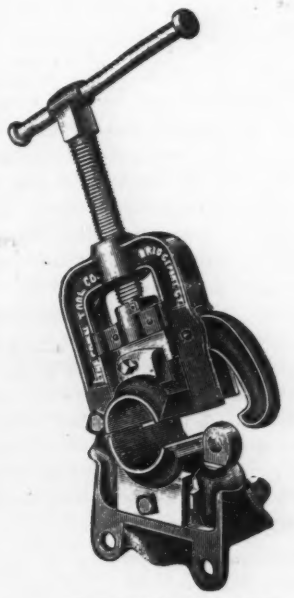
A Cheap Torch and a Reversible-Hinged Pipe Valve.

The *Engineer* should be given credit for the mention that a simple torch for use in the shop can easily be made from short pieces of iron pipe and caps. The torch so made is shown in the illustration. The body is made of 2-inch pipe, about 8 inches long, while the base and top are made of caps of 2-inch inside diameter. The top is drilled and tapped for ¼-inch pipe, and a pipe of this size, 7 inches long, passes through it and projects about 3 inches from the top. This serves as a wick holder, the wick being of the ordinary candle wicking. The torch will be more stable if about 5 pounds of lead is run into the base.

The hinged pipe vise herewith shown reveals the important feature of being reversible so that it will open either at the right or left side, which is accomplished by reversing the top. When in use the jaws, which are self locking, are held in place by means of a latch following the modern practice of this type of tool. The vise is made of malleable iron, with jaws of crucible steel, milled and tempered, which



Reversible Feature.



Brass or Nickle Pipe Jaws.

can be resharpened. The screws are made of machinery steel. The tool is made in too sizes: 1*A*, taking pipe ⅛ to 1½ inches; 2*A*, from ⅛ to 4½ inches. The 1*A* vise may be quickly fitted with jaws for holding brass or nickel pipe from ⅝ to 2 inches in diameter, as shown in the cut to the right, and these jaws do not mar the pipe. The manufacturer of the vise is the Connecticut Tool Company, Bridgeport Conn.

Manurial Value of Sulphate of Ammonia.

The *Journal of Gas Lighting* notes that in the pamphlet issued for this year by the Lawes Agricultural Trust, recording the work accomplished and the new departures arranged for, it is stated that large yields of crops were obtained in fields manured with sulphate of ammonia. An interesting illustration of the after-effects of manures is afforded by the experiments on unmanured barley on the potato plots, which had been variously manured for 26 years. Large yields of barley were obtained in the first year (1902); and in 1903 the yield, though much less on all the plots than in 1902, was about twice as high on the plots to which ammonium salts or nitrate of soda had been applied for the last time in 1901 as on the continuously unmanured plot, while on the plots which had been furnished with a complete mineral fertilizer as well as with nitrogen, the yield was nearly three times as high.

The institution of new experiments on the cropping and disease resisting powers of nine varieties of potatoes, and on mangels and swedes, in which the manurial effect of calcium cyanamide will be compared with sulphate of ammonia are also recorded. Calcium cyanamide (CN·NCa) is obtained by passing atmospheric nitrogen over heated calcium carbide, and is an intermediate product in the formation of sodium cyanide. By this means 40 parts of calcium can fix 28 parts of nitrogen; and it has been found that, by heating with water under

pressure, all the nitrogen of the crude or of the pure cyanide is converted into ammonia, thus—

$$CN\text{-}NCa + 3H_2O = CaCO_3 + 2NH_3.$$

It was reported at the International Congress of Applied Chemistry held in Berlin last year, that experiments conducted by Wagner at Darmstadt and by Gerlach at Posen had shown that calcium cyanamide, applied directly to land, has a manurial value at least as high as an equivalent amount of nitrogen in sulphate of ammonia, and not far below that of nitrate of soda. It was hoped that the crude calcium cyanamide containing from 14 to 22 per cent. of nitrogen, and possibly cyanamide itself containing 66 per cent. of nitrogen, would become recognized as valuable artificial manures. At the meeting, it was announced that calcium carbide as a starting point had been superseded by the action of nitrogen in an electric resistance furnace on a mixture of lime and carbon, and that by a simple lixiviation process the calcium cyanamide could be converted into the crystallizable, easily purified dicyandiamide, thus—

$$2\,(CN\text{-}NCa) + 4\,(H\text{-}OH) = (CN\text{-}NH2)_2 + Ca\,(OH)_2.$$

This $(CN\text{-}NH2)_2$ fused with sodium carbonate is largely converted into pure sodium cyanide, ready for the market without further treatment, while ammonia escapes as gas to be absorbed by sulphuric acid. The following equation is suggested as an explanation of the reaction:

$$(CN\text{-}NH2)_2 + Na_2CO_3 + 2C.$$
$$= 2NaCN + NH_3 \times H + 3\,CO \times N.$$

Mr. Alfred D. Hall, M.A., in a communication to the Chemical Society, has been comparing the effect upon soils of manures such as ammonium sulphate and sodium nitrate. He first explains that the mechanical is quite of equal importance to that of the chemical condition of the soil, and that chemists engaged in the investigation of this subject have agreed upon the term "klay" to represent the particles having a diameter of less than 0.002 mm. These fine particles, which expose relatively the greatest surface to the air, are those which are most active in the growth of plants or cereals; and the author finds that their distribution below the surface of the ground is determined in some degree by the manure employed. The following abbreviated table, giving the percentages of "klay," shows the conclusions arrived at—viz., that sulphate of ammonia preserves the finest particles (the "klay") in the upper layers of the soil, while sodium nitrate tends to carry them to lower levels, thus taking them away from the plane of aërial activity.

Mechanical Analyses of Soils and Subsoils, Broadbalkfield, Rothamsted.

Depth.	Unmanured.		Minerals and Ammonium Salts.		Minerals and Sodium Nitrate.	
	Dried at 100° C.	Ignited.	Dried at 100° C.	Ignited.	Dried at 100° C.	Ignited.
First, 0 to 9 in.	17.3	14.9	17.5	14.9	16.5	13.6
Second, 10 to 18 in.	26.6	23.2	29.2	25.7	30 2	26.5
Third, 19 to 27 in	38.8	34.2	38.2	34.3	43.1	38.9

Paul Wagner and his coadjutors have tested the soil and the yield of crops when sulphuretted ammonia and nitrate of soda were employed, and have arrived at the following results: The addition of farmyard manure, both alone and in conjunction with sodium nitrate, to garden soil, resulted in a loss, followed by an increase in the total amount of nitrates. In the soil alone, and in soil to which nitrate of soda alone was added, the amounts of nitrates remained constant during the whole time (64 days). In another experiment, the application of farmyard manure to soil diminished the amount of nitrate present; while when ammonium salts were added in addition to farmyard manure, the reduction in the amount of nitrates was limited to the first 12 days, instead of 96 days, and was followed by a considerable increase till 96 days had passed, after which the nitrates again diminished.

Field experiments showed that the average yield of oats, barley, wheat, rye, potatoes, sugar beet, and mangels was 70 when manured with ammonium salts, as compared with 100 for sodium nitrate. Of the total nitrogen, 43 per cent. was utilized by the crop, when $(NH_4)_2SO_4$ was employed and 62 per cent. with $NaNO_3$. Ammonium salts gave better results than nitrate of soda with barley and oats.

Herr Clausen states that in 1901, with high rainfall in April and May, ammonium salts gave very good results; the yields of winter rye and potatoes being considerably greater than with sodium nitrate. In 1902, with a dry April and a wet May, the latter gave the best results with rye, while with oats they were obtained with ammonium salts.

The Law Relating to the Escape of Electricity.

By W. Valentine Ball, M.A.

Amongst the legal problems to which the use of electricity has given rise, perhaps there is none of greater interest than the question whether and how far an electric supply company can be held liable for the damage caused by an escaping current. The solution of the question is by no means free from complexity, either in England or America; and it may, therefore, be profitable to discuss, in so far as it is possible to do so within the scope of a short article, the principles which appear to have been adopted by the courts. As will presently be shown, the legal principles which decide the question appear to be the same on both sides of the Atlantic. Having reviewed the cases which have arisen in relation to the escape of powerful amounts of electricity, we shall hope to discuss the questions which are likely to arise in connection with the transmission of wireless messages.

A powerful current of electricity which is passing along the mains of a supply company, or returning through earth, may do mischief in one of two ways, *e.g.*, by induction, as in the case where it affects the working of telegraphic apparatus, or by setting up electrolytic action, by which iron pipes beneath the soil belonging to gas or water companies are sometimes corroded. If damage is caused in either of these ways it is necessary to see whether the company which has generated the escaping current can be held responsible in any and what degree. It is proposed to approach this question, in the first instance, without regard to the statutory protection, express or implied, which is so often conferred upon a company or municipality, who are carrying out a public work for the public benefit.

In England it has been declared that any man who brings anything on to his land which may escape and do damage to his neighbors' property, must keep it there at his peril, and the very fact of its escaping is *prima facie* evidence of negligence. This principle was settled in relation to water in the case of Fletcher v. Rylands (1868, L. R. 3 H. L. C., 330). There the defendant had made an artificial lake on his estate. The water broke through and flooded certain shafts in a mine belonging to the plaintiff. The defendant was held liable. Mr. Justice Blackburn stated the principle to be that anyone who brings on to his property something which is not naturally there, harmless to others so long as it is confined to his own property, but which he knows to be mischievious, if it gets on his neighbors' land, must keep it in at his peril, "and ought to be obliged to make good the damage which ensues if he does not succeed in confining it to his own property." It was of the very essence of this decision that the plaintiff was injured through no fault of his own. Quoting Mr. Justice Blackburn, Lord Cavin. in giving judgment in the highest legal tribunal in England, the House of Lords, said at p. 349 of the report: "The person whose grass or corn is eaten down by the escaping cattle of his neighbor, or whose mine is flooded by the water from his neighbor's reservoir, or whose cellar is invaded by the filth of his neighbor's privy, or whose habitation is made unhealthy by the fumes and noisome vapors of his neighbor's alkali works, *is damnified without any fault of his own.*"

The principle of Fletcher v. Rylands, modified, as we shall endeavor to show, in a very material particular, has been applied to electricity both in America and England, and the fact that the question of its application to electricity was first raised and decided in America is but one further illustration of the start which America has had over England in the race for supremacy in the matter of electrical development.

That the doctrine of Fletcher v. Rylands, even in relation to escaping water, was received, but only with an important modification in America, appears from the case of Pixley v. Clarke (32 Barbour's New York reports). There the Court held as follows:

"Individuals owning the bed of a stream, and each bank thereof, have a right to build a dam and embankment, and to raise the water of the stream as high as they please, subject only to restriction resting upon all, so as to enjoy their own property as not to injure that of another person, with the qualifications and limitations incident to that right of property. And if in the exercise of that right they build with due care an embankment to prevent the water when raised by their dam above the natural banks of the stream, from overflowing the lands of adjacent owners, and in consequence of raising their dam the water finds its way through their own natural soil, and below the surface thereof, by filtration, percolation or otherwise, to the land of an adjacent proprietor, the owners of such dam and embankment are not, in the absence of any unskillfulness, negligence or malice, liable to such adjacent proprietor for any damage he may sustain thereby, the injury being *damnum absque injuria.*"

In the case of Cumberland Telephone and Telegraph Company v. United Electric Railway Company (1890), 42 Fed. Rep. 273, the head note was as follows: "*In the present state of electrical science* a telephone company cannot maintain a bill for an injunction against the operation of an electric railway to prevent damages incidentally sustained by the escape of electricity from its rails." The importance of the words printed in italics will presently be realized. The facts of this case may be thus epitomized: The plaintiff telephone company had obtained legislative authority to construct and maintain telegraphs and telephones, or other lines necessary for the speedy transmission of intelligence along and over certain highways in Nashville, Tenn. Defendants were five street railways, all operated by electricity, under the Sprague and Thomson-Houston systems, and using a trolley or overhead wire. By an act approved March 21, 1887, amending the general incorporation laws, all street railways thereafter organized under the general laws of the State were authorized to propel their cars by electricity. By another act, approved February 28, 1899, all street railway companies which before that time had operated cars by animal power, were empowered to operate the same by electricity, provided the city gave its assent. Acting under this supposed authority one of the defendants, the McGavock and Mt. Vernon Company, proceeded to equip a portion of its road with electricity. Thereupon and on April 17, 1889, the complainant filed a bill in the Chancery Court to enjoin it. Before the cause was heard the parties entered into an agreement by which the telephone company agreed to dismiss its bill, to elevate all its wires which might interfere with the operation of the road, to use all means to prevent their wires from coming in contact with the trolley wires of the road, and not to interfere further with the operation of the road, the railroad company agreeing, upon its part, to construct at its own expense a return metallic circuit, for the use of the telephone company, "whenever it is ascertained that its service is being injured by electricity generated by the railway company, and to use all necessary precautions to prevent the telephone wires from coming in contact with its own wires." In January, 1890, a similar agreement was made between the telephone company and the City Electric Railway, with a proviso that if, upon a fair trial, the return wire should not protect the telephone company from substantial injury, the parties should be remitted, without prejudice, to their legal rights and remedies as they existed before the agreement was made. The action was brought to determine the nature of these legal rights. It was alleged that the metallic current had not given the relief anticipated, and that the complainant was not estopped by the agreement. It was asserted that the electricity returning through the earth reached the wires of the telephone company through various agencies, and that this current produced load lagging noises and greatly interfered with the accurate working of the instruments. It was also averred that the service was interfered with by induction, where a varying current of electricity, conveyed on a conducting wire, will produce in a parallel wire other amounts of electricity. The defendants, among other pleas, urged that the complainants were not entitled to a monopoly of the earth for the return circuit, and insisted that it should make use either of a complete metallic circuit or of a device known as the "McCluer Device" for its return circuit.

After a lengthy review of numerous cases bearing upon the point, Brown, J., said: "The substance of all the cases we have met with in our examination of this question is that, where a person is making lawful use of his own property, or of a public franchise, in such a manner as to occasion injury to another, the question of his liability will depend upon the fact whether he has made use of the means which, in the progress of science and improvement, have been shown by experience to be the best; but he is not bound to experiment with recent inventions, not generally known, or to adopt expensive devices when it is within the power of the person injured to make use himself of an effective and inexpensive method of prevention. If, in the case under consideration, it were shown that the double trolley would obviate the injury to the complainant without exposing the defendants or the public to any great inconvenience or a large expense, we think it would be their duty to make use of it, and should have no doubt of our power to aid the complainant by an injunction; but, as the proofs show that a more effectual and less objectionable and expensive remedy is open to the complainant, we think the obligation is upon the telephone company to adopt it, and that the defendants are not bound to indemnify the complainant; in other words, that the damage incidentally done to the complainant is not such as is justly chargeable to the defendants. Unless we are to hold that the telephone company has a monopoly of the use of the earth, and of all the earth within the city of Nashville for its feeble current, not only as against the defendants, but as against all forms of electrical energy which in the progress of science and invention, may hereafter require its use, we do not see how this bill can be maintained." In the event the injunction was refused. It is conceived, however, that the result might have been otherwise if the telephone company had been unable to effect an improvement by a comparatively slight modification of their system.

The law in America seems to have been well and succinctly stated by Judge Woodworth, in Panton v. Holland (7 Johns. 92) where he said: "On reviewing the cases I am of opinion that no man is answerable in damages for the reasonable exercise of a right, when it is accompanied by a cautious regard for the rights of others, when there is no just ground for the charge of negligence or unskillfulness, and when the act is not done maliciously."

Mr. Simon Croswell, in his admirable work, "The Law Relating to Electricity" (1895), gives references to a number of cases which are analagous to the above, and says (p. 213): "In almost every instance the courts have held that the telephone company should make the necessary change, because the telephone, as a species of telegraph, uses the highways in subordination to the right of public to travel thereon, and the electric railway is a form of this travel."

We have said that American lawyers have recognized the principle of Fletcher v. Rylands, but the above case will show that they have only done so to the extent that a man who brings anything on to his own land must use the best means known to science to prevent its escape; if, after such precautions, there be an escape, it becomes the duty of a neighbor to protect himself as well as possible.

After passing through a certain period of doubt and hesitation, the English courts seem to have arrived at the same conclusion. The point was first raised in the case of the National Telephone Company, v. Baker (1893), 2 Ch. 186. There a tramway acting under a provisional order (*i. e.* under statutory authority) and using the then best known system of electrical traction (*i. e.*, orerhead wires and return through insulated rails), caused electrical disturbances in the wires of a telephone company. These disturbances prevented the telephone being used. It was proved at the trial that the use of a second wire by the plaintiffs would have completely cured the disturbances complained of, but it was also proved that nearly the whole of the plaintiff company's telephone business throughout the country was carried on by means of the single wire system. An action having been brought by the plaintiffs, the defendants pleaded (as the defendants in the American [*ubi supra*] case can also pleaded) that an alteration of the plaintiff's system would have minimized the nuisance. With regard to this plea the judge said tkat inasmuch as the plaintiffs were carrying on their own business lawfully, he could not put to them the expense of altering it merely for the purpose of enabling the defendants to run their trains without creating a nuisance. As events turned out this opinion became a mere *obiter dictum;* that is to say, an expression of opinion which was not material to the issue, as the case was decided in favor of the defendants because they were expressly authorized by statute to use electric power, and the learned judge held that the legislature must, therefore, have condoned by anticipation any mischief arising from the reasonable use of such power.

It was not until 1902 that an English court adopted the rule of law which, as we have seen, was laid down in America 12 years before. In 1902 the cause of the Eastern & South African Telegraph Company, Limited, v. the Cape Town Tramways Companies, Limited (1902, A. C. 381), came before the judicial committee of the Privy Council, on appeal from the Supreme Court at the Cape. There the defendant company owned certain tramways worked on the overhead wire system, and having uninsulated returns, which ran along the sea front in Cape Town and its suburbs. Part of the line was worked under statutory protection, and part of it was worked without statutory authority. The plaintiff company owned a submarine cable which runs out to sea hrough Table Bay.

It was found that at some point in Table Bay electricity having escaped and being at large, was attracted to the telegraphic cable. Entering the sheathing it found its way back to the tramway central station and so completed the circuit. While traveling along the sheathing the intensity of the current varied frequently at irregular intervals and gave rise to such induced currents in the core of the cable as to render it practically useless for the transmission of messages. In these circumstances the plaintiff company were put to great expense to effect a remedy, and in the event it was found that by laying a second cable parallel to the first all through the sphere of influence, the mischief was abated. They sought by action to restrain the tramway company from so carrying on their business as to be a nuisance, and incidentally to recover, by way of damages, the expenses to which they had been

put in making experiments and laying the necessary protecting cable.

Owing to the fact that a section of the tramway was worked otherwise than by statutory power, the question of the tramway company's liability in law was distinctly raised.

The Colonial Courts having found in favor of the defendants, the telegraph company appealed to the Privy Council. At the hearing the American case of Cumberland Telegraph and Telephone Company v. United Electric Railway Company (*ubi supra*) was referred to. The plaintiffs, however, relied upon the simple doctrine of Fletcher v. Rylands to give them a cause of action. In giving judgment Lord Robertson said: "If regard be had solely to the action of the respondents in storing electricity on their lands, it must be allowed that the analogy is very close to the illustrations given in Rylands v. Fletcher of the kind of things which an owner can only do at his own peril. Electricity is capable, when uncontrolled, of doing injury to life and limb, and to property; and in the present instance it was artificially generated in such quantity and it escaped from the respondent's premises and control. So far as the respondents are concerned, it appears to their Lordships that given resulting injury such as is postulated in Rylands v. Fletcher, and the principle would apply. But this is only half the question, and it remains to be seen if the injury postulated is present. * * * The true comparison is with things used in the ordinary enjoyment of property, and this cable differs from such things in its peculiar liability to be affected by even minute currents of electricity. Having regard to the appellant's argument, it seems necessary to point out that the appellants, as licensees to lay their cable in the sea, and as owners of the premises in Cape Town, where the signals are received, cannot claim higher privileges than other owners of land, and cannot create for themselves, by reason of the peculiarity of their trade apparatus, a higher right to limit the operations of their neighbors than belongs to ordinary owners of land who do not trade with telegraphic cables.

"If the apparatus of such concerns requires special protection against the operations of their neighbors that must be found in legislation, the remedy at present invoked is an appeal to a common law principle which applies to much more usual and less special conditions. A man cannot increase the liabilities of his neighbors by applying his own property to special uses, whether for business or pleasure. * * * Nor need the law be regarded as showing any want of adaptability to modern circumstances if this be the true view, for the liability thus limited is of insurance."

Thus the courts of the two great English speaking nations have arrived at the same conclusion on this all important question.

Hitherto we have considered the question of liability independent of statute. Consideration of the authorities seems to warrant the conclusion that both in England and America the fact that electricity is being used under statutory power will excuse the company from liability. Liabilities on this head are as a rule only imposed where there is some element of negligence. In the Cape Town case, for instance, the company specially undertook by an agreement which was incorporated with and formed part of the statutory power under which they worked the greater part of their tramway, that in the event of any electric leak taking place and doing injury by electrolysis or otherwise, that they would make good the loss. In the opinion of the Privy Council, however, the injury done by the return current in the submarine cable was not the result of a leak. "It was," to use Lord Robertson's words, "on the contrary, a natural incident of the operations legalized under the statutes."

Thus has the law been settled and its settlement has been a matter of far-reaching importance to electrical companies of all kinds. It has compelled telephone companies to adopt the 2-wire system and to adopt every other improvement which is capable to rendering the service immune from injury which might be sustained owing to the vicinity of heavy current mains. Nor has the above declaration of the law been without its effect upon subsequent legislation within the British Empire.

By a statute recently passed in Natal a tramway company was specially enjoined not to so conduct its business as to cause any interference with a neighboring submarine cable.

With regard to electrolysis caused by escaping electricity, it will be at once appreciated that injury from this source can only be caused by the negligent laying or up-keep of mains; and it is conceived that no legislature would ever excuse an electric supply company from the consequences of such negligence. Upon this head we have only been able to find one case, namely, that of the Manufacturers Natural Gas Company v. Indianapolis Street Railway Company, which was heard in Indianapolis, U. S. A., in 1901.[1] It seems to warrant the inferences (*a*) that there must be no negligence in the exercise of a franchise, aud (*b*) that every possible precaution must be taken to prevent injury being caused by the escape of electricity from mains. The action there was brought io recover damage for injuries caused to gas pipes by electricity which had escaped from a badly insulated main. In the judgment there appeared the following passage: "The method in use by the defendants in operating their cars results in serious injury to and in some cases destroys the plaintiff's pipes. The defendants can, by use of an approved appliance at reasonable expense so operate their cars as to avoid injuring the plaintiff's pipes; while the plaintiffs cannot, by any known method, protect their pipes from injury. The plaintiffs own the pipe line laid in the street by legal authority. and such pipe line is property within the meaning of the constitution and laws. It is subject to taxation, and it may be sold and purchased like other property. The street railway company seizes on these pipes and makes use of them as a conductor for their return current, and, in so doing, greatly injures and in some instances wholly destroys them; and this is done under a claim that they are performing a public service under legal authority. Is not this a taking of private property for public use, for which just compensation must be made? These questions are new and we are without precedent in decided cases for our guidance, but it would be a reproach to our system of jurisprudence, and the administration thereof, if a situation could arise in which large and material injury should be done to legal rights, and destruction caused to property, while the law was powerless to apply a remedy. * * * Where a corporation is exercising a public franchise and does so in such a manner as to cause actual material injury to legal rights and destruction of property, *when at a reasonable expense, by the adoption of well known and approved* appliances, the injury would be avoided, and the person injured is powerless to prevent or guard against such injury, then I think it must be held to be negligence in the use of its franchise on the part of such corporation not to adopt such approved appliances.

In England, however, the legislature has considered it expedient upon one or two occasions to expressly reserve this liability to the tramway company. Thus, Section 46 of the city of Birmingham Tramways Act, 1901, provides that, "If it be provided that any injury or damage to any gas or water pipes, or other metallic pipes belonging to the corporation, shall have resulted from fusion or electrolytic action caused by any currents generated or used by the company for the purpose of electric traction under this act, nothing in this act shall relieve the company from any liability to make compensation for any such injury or damage, which would not have existed but for the passing of this act."

Passing on to the question of wireless telegraphy, it is conceivable that the messages from a transmitter belonging to one person might affect and seriously incommode the working of a receiver belonging to someone else. In the light of the above statement of the law of escaping electricity, could any redress be sought? It is thought not. It may be true that in sending messages broadcast from a transmitter a man is discharging something (if such a word is appropriate) from his own property, which may be a source of inconvenience to his neighbor, but it is conceived that if any neighbor makes use of a receiver he must either be content to submit to interference with his messages or else take such precautions whether by "tuning" his transmitter or otherwise, as to prevent his instrument being affected. Such, it is conceived, is the principle of law applicable to wireless telegraphy, In using a receiver a man uses a highly delicate instrument, and if his neighbor's messages reach him accidentally he has no redress in law. There remains a question of greater nicety. Suppose the owner of a receiver of wireless messages records a message sent from a transmitter belonging to someone else, can he be restrained from making use of that message? No case in relation to telegraphs has arisen in England which is likely to give any clue to the solution of a problem of this kind. This is probably because the telegraph has so long been a government monopoly that no one has ventured to tamper with it. Further, an act of Imperial Parliament which was passed in the present year to bring the use of wireless telegraphy under state control, is silent with regard to the question under discussion.

With regard to America, although there are acts in force in some States which prohibit the disclosure of telegraphic messages, the writer has not been able to trace any measure which penalizes the stealing of a telegram; and there does not appear to have been any legislation with regard to wireless telegraphy in the United States.

1. See *Traction and Transmission*, Vol. II., Sept. 1901. p. 4.

Some Refinements of Mechanical Science.[1]

By Ambrose Swasey.

I wish to speak of a few of those methods and mechanisms which have been developed and perfected to such a degree of refinement that they may be considered as almost beyond the practical, and yet were it not for such refinements they could not possibly be made to serve the utilitarian purposes which make them of such inestimable value to us all.

The division and the measurement of time is to-day, as it has been for ages, among the most important of the subjects affecting the welfare of mankind.

The diurnal revolution of the earth, which gives the solar day, and the revolution of the earth around the sun, the solar year, are the arbitrary divisions of time marked off with the utmost precision by the celestial bodies; and while the length of the solar day has, from before the Christian Era, been fairly well defined, the length of the solar year was but approximately known until within a few hundred years.

The length of the year as counted by the Julian calendar was too long by 11 minutes and 14 seconds, and this error amounted to 10 full days in the 1,000 years from the time the Julian calendar went into effect until the introduction of the Gregorian calendar.

A few years ago, when visiting the Vatican Observatory, I was particularly interested in the Gregorian Tower, which forms a part of the Vatican Library Building. After passing through a number of rooms which are used in connection with the Observatory, when near the top of the tower, I was taken into the spacious and beautiful calendar room, the walls of which are covered with paintings of the highest order, executed centuries ago, under the direction of Pope Gregory XIII. In the center of the room, and forming a part of the floor, there was a large marble slab, on which was cut a fine line exactly in the true meridian, and upon the line was a special mark which indicated the altitude of the sun at noon of a certain day. On the south wall, near the top of the room, there was a small aperture through which the direct rays of the sun passed at noon, projecting a bright spot on the meridian line.

All of this had been planned and executed by the astronomers in order that they might demonstrate the necessity of reforming the calendar, and when at noon on the 23d of March, 1582, Pope Gregory saw that the altitude of the sun as shown by the beam of light was not for that particular day, but for the day 10 days previous, he directed that 10 days be stricken from the calendar and that day should be the 11th of March instead of the 23d.

With such precision had the astronomers determined the true length of the year, that our present calendar with its intercalations will continue on for 20,000 years with an error not to exceed a single day.

Since an unknown time the day has been divided into 24 hours, and as civilization has advanced, the greater has been the necessity for the utmost precision in the measurement of each hour, with its subdivisions.

The sun dial is not only the earliest, but the most interesting of all the numerous arrangements that have been devised for measuring the divisions of the day. Notwithstanding its limitations, it has been a subject which has attracted the brightest minds for ages. Within these later years there has been a renewed interest in this ancient timekeeper, not only in copying the types of dials, which are valuable because of their antiquity, but in working out new forms. Recently a new dial has been invented by which the rays of the sun will indicate the true mean time for each day of the year, with an error not to exceed 1 minute.

The hour glass, which came later, was considered a much more practical method, inasmuch as it could be used either day or night, and because its use was not confined to a particular location; however, as a timekeeper it was not satisfactory, even in those early days.

The clepsydra or water clock, which is supposed to have been invented by the Greeks, was found to be a much better timekeeper than either the sun dial or hour glass, and it was a great step in advance toward the accurate measurement of time.

These water clocks are to this day used extensively in the East, more especially in China. Those first used by the Greeks consisted of two water jars so arranged that the water from the upper ran into the lower, and the time of day was determined by measuring the depth of water in the upper jar, and at sunrise each day the water was returned to the upper jar. In the city of Canton there is a water clock which has been running for 800 years, and at the present time it is the standard clock of that city.

This clock consists of 4 water jars, each having a capacity of 8 or 10 gallons. The jars are placed one above the other in the form of a terrace, the three upper ones being provided with a small orifice near the bottom, through which the water drops into the jar next below, and so on down from one to the other, until the water reaches the lowest or registering jar. In this there is a float, to which is attached an upright having graduations for the hours and parts of hours, and as the water rises the time can be determined by noting the height of the float in relation to the crossbar at the top of the jar.

In this improved form of water clock the variation in the flow of water due to the difference in height is overcome by having a series of jars, the outlet of the upper being so graduated that there is but little variation in the height of water in the second jar, and in the third the height remains practically uniform, thus insuring a constant head for the water which drops into the registering jar. At the beginning of each day the water is taken from below and carried up a flight of steps to the top.

Clocks of the present type, although used as far back as the twelfth and possibly earlier, were but fair timekeepers, until several centuries later. Those which the astronomers used in the observatories at the end of the fifteenth century were so unreliable that modified forms of the clepsydras of the ancients were used, and as they did not prove to be satisfactory, most of the observations were made without the use of clocks.

Galileo's beautiful discovery of the isochronism of the pendulum from the swinging chandelier in the church at Pisa was of great value in many respects, but in none more so than in its application to the measurement of time.

Soon after that great discovery, the English clockmaker, Graham, invented the mercurial pendulum, by which the variation in its length caused by the difference in temperature was fully compensated, and some years later Harrison, another English clockmaker, invented a compensating pendulum, which consisted of a series of metal bars having different co-efficients of expansion—so that 200 years ago, as it is to-day, the pendulum was the nearest perfect of all the devices that have been employed for governing or controlling the motions of a clock mechanism.

Every part of the clock down to the minutest detail has been the subject of study and improvement, and they are made and adjusted with such precision and delicacy that in testing them the question is, within how small a fraction of a second will they run? Not content with their marvelous performance when under normal conditions, some of the finest astronomical clocks are surrounded by glass or metal cases, in which a partial vacuum is maintained, and in order that the cases may not be opened or disturbed, the winding is done automatically by means of electricity; the frequency of the winding in some cases being as often as once every minute. These clocks are set up in especially constructed rooms or underground vaults, where they are free from jar or vibration, where the temperature and barometric conditions remain practically constant, and where every possible precaution is taken to further minimize the errors of the running rate.

A clock in the Observatory at Berlin has run for several months under these favorable conditions, with a rate having a mean error of but fifteen one-thousandths of a second per day and a maximum error of thirty one-thousandths of a second per day.

Another clock installed at the Observatory of Case School of Applied Science at Cleveland, running under similar conditions, also has a mean error of fifteen one-thousandths of a second per day, with a maximum error for several months of but twenty-two one-thousandths of a second per day.

From the time of the invention of Peter Hele, in 1477, of the "Nurnberg Animated Egg" or "pocket clock," which required winding twice a day and varied an hour and a half in the same length of time, the development of the watch has kept pace with the "Mother Clock," and followed closely to it in timekeeping qualities.

The larger watch, or ship chronometer, with its escapement so delicately made and adjusted that it must always be kept in the same position, was greatly improved through the efforts of the British Government in 1714 by offering rewards of £10, £15 and £20,000 to any who should make chronometers that would run so accurately that the longitude of a ship at sea could be determined within 60, 40 and 30 miles, and Harrison, the inventor of the compensating pendulum and the compensating balance, which is now used in watches, succeeded in making a chronometer, which, after being tested on a long voyage, was found to run so closely that the position of the ship was determined within 18 miles, and he was therefore paid the full award of £20,000.

1. From the Presidential address at the New York meeting of the American Society of Mechanical Engineers.

That historic chronometer, which marked a new era in navigation, is now numbered among the treasures of Greenwich Observatory.

Long before the telescope was invented, Tycho Brahe, the Danish astronomer, "the founder of Modern Astronomy," constructed for his observatory, instruments of various kinds having graduated circles and arcs of circles. His instruments for the most part were improvements on those used by Arabian astronomers in the eighth and ninth centuries, and these in turn were copied after similar instruments used by the Greeks and Egyptians a thousand years previous, and it is supposed that such instruments were used by the Chinese at an even earlier period, so that graduated circles have come down to us from the far-off ages.

The longer the radius the more accurate the graduations was the principle upon which the early instruments were made. The Arabians, in about the year 1,000, built a sextant with a 60-foot radius and a quadrant with a 21-foot radius, but to Tycho Brahe is due the credit of constructing instruments having circles much smaller in diameter and graduated with a greater precision than ever before. It was by the use of such improved instruments of his own making, and by his observations which were made without a telescope or any means of magnification, that he was able to give the positions of a large number of stars within less than 1 minute of arc from the positions given by modern astronomers.

The graduation of an 8-foot mural circle in 1725 by Graham, of England, for the National Observatory, and of an 8-foot quadrant by Bird, in 1767, were notable steps in advance in the division of the circle and the measurement of angles, but these and similar instruments, although their efficiency was greatly augmented by the use of the telescope, have been supplanted by others more practical. The first circular dividing engine was made in 1740 by Henry Hindley, of New York, for cutting the teeth of clock wheels, and it is interesting to note that in the same year Huntsmann, another clock maker, of Sheffield, invented the process of making crucible steel, that he might have a metal suitable for the springs of his clocks.

Of the several engines constructed later, the one most successful and representing the greatest progress was that made by Ramsden in 1777. This engine, automatic in its movements, was made especially for graduating circles, and because of the great precision with which he divided the circles of the instrument used by the Government, the Board of Longitude awarded him the sum of £615. A further and most potent recognition of the excellence of his work lies in the fact that all subsequent circular dividing engines have followed closely the same general principles of construction embodied in the Ramsden engine.

It is most gratifying to all those who are interested in mechanical progress that the Ramsden engine has been preserved throughout all these years, and it now stands in the Museum of the Smithsonian Institution, at Washington, as a monument to the one who made it and as the best example of that time of the art of graduating circles.

The graduation of circles for astronomical instruments is one of the most difficult of all mechanical problems.

In such an engine the chief essential is that the spindle carrying the master plate shall be as nearly round and as closely fitted in its bearings as is possible, for the degree of excellence with which that work is done determines how closely a circle can be divided.

The greatest accuracy thus far attained in such engines in 1 second of arc, which arc with a radius of 3 miles equals 1 inch, and at 20 inches, which is the radius of the silver ring upon which the graduations on the master plate are made, a line 0.001 inch in width is equal to 12 inches of arc, or 12 times the accumulated errors of any number of divisions, or 20 times the greatest error of any single division.

In automatically graduating a circle, it has been found to be impracticable to cut more than 6 lines in a minute, and it requires about 33 hours to divide a circle into 2-minute spaces. As with the running of the finest clocks, the best results can be obtained only when the engine is surrounded with every favorable condition possible. Instead of the large circles and sectors used by the ancients, they have been made smaller in diameter as the methods for graduating have been improved, until those of the more modern instruments are seldom more than 30 inches, and some of the latest meridian instruments have circles of but 25 inches.

The smaller circles, which can be made and graduated with greater precision than the larger ones, are also less liable to change in form, owing to their weight and the variation in temperature, and with the aid of the reading microscope the results obtained would not be possible with the larger circles.

A 25-inch circle read with a microscope having a power of 40, would be equivalent to a circle of about 80 feet in diameter, and a single second of arc as seen through the microscope would be edual to 0.004 inch, a quantity easily subdivided.

A most important adjunct to the astronomer's instrumental equipment is the filar micrometer. With it he determines the errors of divisions, the eccentricity of his circle and measures the angles to within a fraction of a second; and when used at the eye end of the telescope he determines the positions and motions of the stars and the distance and diameters of the planets. In these little instruments, whether of the simple or complex form, the chief requisites are the screw and the cross wires, for upon them the value of the observations and measurements depends.

To make the screw of a micrometer so true that the errors in the threads cannot be detected by its own magnifying power is an extremely difficult task. These micrometer screws are often made with 100 threads to the inch, and are provided with graduated drums having 100 divisions, the readings being made in 10ths of a division.

The cross wires, which are but common spider lines, because of their fineness and the remarkable qualities they possess, are indispensable in micrometric work.

The spider lines mostly used are from $\frac{1}{2}$ to $\frac{1}{4}$ of a 1,000 of an inch in diameter, and in addition to their strength and elasticity, they have the peculiar property of withstanding great changes of temperature, and often when measuring the sun spots, although the heat is so intense as to crack the lenses of the micrometer eyepiece, yet the spider lines are not in the least injured.

The threads of the silkworm, although of great value as a commercial product, are so coarse and rough compared with the silk of the spider that they cannot be used in such instruments. Platinum wires are made sufficiently fine and make most excellent cross wires for instruments where low magnifying powers are used, yet as the power increases they become rough and imperfect.

Spider lines, although of but a fraction of a thousandth of an inch in diameter, are made up of several thousands of microscopic streams of fluid, which unite and form a single line, and it is because of this that they remain true and round under the highest magnifying power.

An instance of the durability of the spider lines is found at the Allegheny Observatory, where the same set of lines in the micrometer of the transit instrument has been in use since 1859.

The placing of the spider lines in the micrometer is a work of great delicacy, and in some micrometers there are as many as 30 which form a reticule, with lines two one-thousandths of an inch apart, and parallel with each other, under the highest magnifying power.

In the realm of the measurement of minute linear distances, and the perfection of curved and flat surfaces, the refinements are even greater than those pertaining to the measurement of time and of angles.

Most important in the linear dividing engine is the screw, and although much had been accomplished in bringing such engines to a high degree of excellence, it was for Professor Rowland to make an engine which has a practically perfect screw; and without doubt it is in all respects the nearest perfect of all the mechanisms that have been employed for ruling lines exactly parallel and equally spaced.

The Rowland engine was made specially for ruling diffraction gratings which are made of speculum metal, and with it a metal surface has been ruled with 160,000 lines, there being about 29,000 to the inch, and as many as 43,000 lines to the inch have been ruled.

The gratings mostly used have from 14,000 to 20,000 lines to the inch, and with such exactness is the cutting tool moved by the screw that the greatest error in the ruling does not exceed one-millionth of an inch.

The production of these gratings, which has enabled the physicist in his study of the spectrum to enter fields of research before unknown, has not only called for the highest degree of perfection ever attained in the spacing of linear distances, but it has also called for a refinement most difficult in the optical surfaces upon which the lines are ruled. To Mr. Brashear was given the problem of producing such surfaces, and notwithstanding the many difficulties encountered in working and refining the speculum metal plates, he has made many hundred plates with surfaces either flat or curved with an error not to exceed 1 tenth of a wave length of light, or 0.0000025 inch.

The established standards of length which are the yard of Great Britain and the meter of France, being made of metal, and liable to destruction or damage, Professor Michelson conceived the idea of determining the lengths of these standards in wave lengths of light, which would be a basis of value unalterable and indestructible.

For the purpose of carrying out these experiments, the interferometer was constructed, an instrument which required the highest order of workmanship and the greatest skill of the optician. Again Mr. Brashear proved to be equal to the occasion, and made for the instrument a

series of refracting plates, the surfaces of which were flat within 1-twentieth of a wave length of light, with sides parallel within 1 second. This was the most difficult work ever attempted in the refinement of optical surfaces.

Professors Michelson and Morley devised a method for using the interferometer, for making the wave length of some definite light an actual and practical standard of length. So satisfactory was the result that Professor Michelson was invited to continue the experiments at the Bureau of Weights and Measures, at Sèvres, France, where the standard meter, which is kept in an underground vault and inspected only at long intervals, was used for that important work, which occupied nearly a year. The final result of the experiments shows that there are 1,553,164.5 wave lengths of red cadmium light in the French standard meter, at 15° C. So great is the accuracy of these experiments that they can be repeated within one part in two millions. Should the material standard of length be damaged or destroyed, the standard wave length of light will remain unaltered, as a basis from which an exact duplicate of the original standard can be made.

Theory of Electrolytic Dissociation.

A paper on recent investigations, bearing on this subject, was read before the Faraday Society in London, on November 23, by Prof. L. Kahlenburg, Ph.D. He said that in creating the theory of electrolysis dissociation, the phenomena of actual electrolysis have played a minor part. It has rather been based on the observation that for many aqueous solutions the molecular conductivity increases with the dilution, and that the osmotic pressure, lowering of freezing point, and similar physical constants are abnormally great. The hypothesis is thus vitally connected with vant's Hoff's theory of dilute solutions which it generalizes in the form of $PV = iRT$ where i, the so-called degree of dissociation, is unity for non-electrolytes and greater than one for electrolytes. The author is of opinion that the theory is supported by isolated facts only.

Comparisons of the molecular conductivites with the freezing points at 0° and boiling points at 95° were made by the author in 1901, with typical solutions of the electrolytes and non-electrolytes, and no such connection between those quantities as demanded by the theory was found.

According to the theory, molecular conductiveness should increase with the volume but in practice that is often not the case.

According to the Nernst-Thomson rule, dissociation is caused by the high specific inducive capacity of the solvent, but cases are cited, such as liquid hydrocyanic acid, where a higher dielectric constant than water has is accompanied by lower conducting—and therefore ionizing—power.

Additive properties are not a valid argument in favor of the theory, because they occur in quantities such as molecular heats and molecular refractions, where ionization is out of the question.

The colors of solutions have been attributed to the free ions present, but copper, nickle, and cobalt oleates are insulators, and yet bear the characteristic colors of the supposed metallic ions.

Instantaneous reactions sometimes occur between insulation solutions and hence cannot be regarded as taking place between the free ions present.

A strong argument against the hypothesis is that it cannot be harmonized with the law of mass action. The agreements obtained by Ostwald in his application of the dilution law to solutions of weak organic acids sre only very rough, and to electrolytes par excellence it cannot be applied at all. Rudolphi's and van't Hoff's amended formulæ are purely empirical.

The power of coagulating colloids has been ascribed to free ions, but such power is not confined to solutions of electrolytes.

It is in the realm of non-aqueous solutions that the theory proves especially impotent. We now know of such solutions that conduct electricity even better than aqueous solutions, and yet yield higher molecular weights than those computed from the formulæ of the solutes. The researches of Walden on liquid sulphur dioxide are quoted as being particularly conclusive.

The theory has been applied to fused salts. The author questions the validity of such application to what are practically 100 per cent. solutions; the hypothesis is avowedly only strictly true for infinitely dilute solutions.

Prof. Kahlenberg does not think the hypothesis can be retained even in a modified form. It must give way to a conception which takes into account the affinity—of the same nature as chemical affinity—between solvent and solute. The processes of solution and chemical action are merely the cleavage pieces of solutions placed under special stress or duress represented by the so-called purifying processes. Thus chemical action is merely a special case of solution, and the process of solution is the general case of the interaction of bodies resulting from their specific attractions for one another. A dilute solution is merely a limiting case. The abnormal values of molecular weights of substances in solution as determined by change of vapor tension, freezing or melting points, is merely a measure of the affinity between solute and solvent, and has nothing to do with any supposed dissociation; the calculation of molecular conductivities is founded upon the erroneous supposition that the solvent plays no part in the conduction. Recent determinations of osmotic pressures by the author have similarly shown that these depend on the nature of both membrane and liquids, and are by no means in accordance with the requirements of the gas laws. Here, again, as in solutions, affinity is the determining quantity.

Mr. W. C. D. Whetham, in a written communication, pointed out that the problem of the nature of solution was independent of the difference between electrolytes and non-electrolytes, which was all the theory attempted to explain. The ions must be conceived as being free from each other, not from all chemical combination, in order to explain the observed phenomena of conduction.

Prof. Abegg, also in a recent communication, said that Prof. Kahlenberg's reasons for doubting the theory are merely facts which cannot be explained by the Arrhenius theory alone. The latter explains the behavior of dilute aqueous solutions, where the non-ionized molecules are, as a rule, not associated, and not cases where association occurs, such as in non-aqueous solutions. The author further overlooks the fact that conductivity depends on the mobility of the ions, as well as on the degree of ionization. The theory can be harmonized with the law of mass action, as the work of Rothmund and Drucker and Jahn has shown.

Dr. T. M. Lowry said that Prof. Kahlenberg's criticisms were mostly expended on a theory which was not the dissociation hypothesis as conceived to-day, The theory does hold good for concentrated solutions, only we are not yet able to measure the degree of ionization in such cases. His laws are not quite true for moderately dilute solutions, because some of the molecules of the solutes are in combination, and not free. He dealth at length with the various points raised by the author.

Dr. G. Rudorf referred to the question of the color of solutions, and showed that on the assumption that the molecule of copper sulphate has nearly the same light absorbing properties as the ion, all difficulties dissappear. The theory quite explains the reactions mentioned in benzine solution, if only very few ions are assumed to be present.

Dr. H. Borns showed that Prof. Kahlenberg's capital mistake was that he attacked everything that had ever been said or done with the theory. He ignored recent modifications of it that the ideas of hydreslysis, complex ions, and association have caused.

Dr. H. Sand (communicated), dealt with the differences between the theory of Clausis, and that of Arrhenius, and discussed some of the approximate assumptions that lead to numerical disagreements in the applications of the latter.

Dr. C. H. Desch discussed Prof. Kahlenberg's experiment with copper oleate in benzine solution, and described some experiments of his own bearing on the subject. He thought the diffculties raised by non-aqueous solutions very serious ones.

Mr. F. S. Spiers drew attention to the theory of Traube, which gave numerical expression to some of the conceptions of solution apparently held by Prof. Kahlenberg, and explained the Arrhenius coefficient i in terms of the affinity between solute and solvent.

The Uniform Bill of Lading.

The long continued protest of shippers against the proposed adoption of the uniform bill of lading, as formulated by the Uniform Bill of Lading Committee of the Central Freight Association, culminated last week in a meeting in Chicago, at which shipping interests from all over the country attacked, and railroad men defended, the proposed instrument, before a committee of the Interstate Commerce Commission. A leading part in the prosecution, if such it might be called, was taken by the attorney for the Illinois Manufacturers' Association and Chicago Shippers' Association, which bodies are to be credited with having stirred up the shipping interests of the country on this subject. The Interstate Commerce Commission was represented by Judson C. Clements, of Georgia, Joseph W. Fifer, of Illinois, and C. A. Prouty,

of Vermont. At the end of the 3 days' session the sentiment prevailed very generally that, while the shippers had made an excellent case, the railroads had little or no case at all. To such an extent was this true that many railroads have already voluntarily notified their customers that they will not adopt the obnoxious bill of lading in its present form at least.

The two clauses of the bill that were most strongly opposed were, first and particularly, the one compelling the shipper to sign a bill of lading, making it virtually a contract, by which the shipper, in consideration of not being charged 20 per cent. advance in rate, relieves the railroad of its common law liability in the matter of loss or damage to merchandise carried. While the railroad attorneys successfully demonstrated that this 20 per cent. clause has been in practically all bills of lading used by American railroads for 8 years, the shippers were able to prove that in no case had the clause been enforced, and that railroads had habitually and customarily paid damages embraced in common law liability to shippers who had not paid the 20 per cent. premium on their freight tariff. It was further shown that while the average expense to railroads for loss and damage to freight ranged from ⅓ of 1 per cent. to 1¼ per cent. of the total freight earnings, the roads now proposed to charge 20 per cent. premium for assuming a liability that they had assumed all along. This 20 per cent. would be virtually, therefore, an increase in freight rates.

Another reason for objecting to this clause was the fact that it left a dangerous loophole for preferential rates to large shippers. In other words, while the 20 per cent. rate might be enforced with small shippers, the large shippers would, by reason of the great amount of tonnage which they had to offer, be able to secure immunity from the enforcement of the clause, giving them practically a rate 20 per cent. lower than their less powerful competitors.

Another objection to the proposed bill of lading was the printing of the words "not negotiable" across its face, and to this feature bankers were the chief objectors. The Bill of Lading Committee stated that this feature would not be enforced at all except in certain States in which State legislation had been enacted making it illegal for railroads to issue bills of lading that were negotiable.

Bankers testified that they could not legally advance money on a bill of lading bearing the words "not negotiable," even though there were printed in small type on the back of the instrument words practically nullifying the printed indorsement on its face. Closely interwoven with the feature of non-negotiability was the one previously mentioned concerning liability of the shipper. For instance a bank which was accustomed to advance up to 75 per cent. of the value of a shipment, under the prevailing usage, could not do so on the new bill except with large and responsible shippers, because the railroad would have no longer legal responsibility for loss of or damage to the shipment during transit. As an example: A car of grain containing 500 bushels, on which banks were accustomed to lending 75 per cent. of the market value of the grain, might easily in transit lose 20 or 25 per cent. of the original shipment, and where there was no recourse against the railroad for this loss, and the shipper was not responsible, the bank would lose a certain percentage of the money loaned. Here, too, the chief objection was that the large responsible shippers would have the advantage, because banks would feel safe in negotiating their bills of lading up to within a small margin of the actual merchantable value of the cargo, while the small unknown shipper would be deprived of that facility.

The meeting was adjourned to reconvene at Washington, D. C., December 15, and the railroads are disposed to push the matter to a conclusion before January 1, as it will have an important bearing on certain changes of rates which they purpose putting into effect on that date.

Wrecking the World's Fair.

Next in difficulty to the task of building a great exposition is the task of wrecking it and making a profitable disposition of the multitude and endless variety of materials which enter into its construction and equipment. The contract has just been closed by which the St. Louis Exposition authorities sell to the Chicago House Wrecking Company everything on the Fair grounds belonging to the Exposition authorities except the trees. The amount paid was something over $500,000. In addition to this the same Company has made individual purchases of State buildings and private structures that did not belong to the Exposition authorities. Wrecking has already commenced, but the maximum activity of the work cannot be reached for some months, until after the exhibits have been safely removed. The great $50,000,000 city of ivory is now a junk proposition. The magnitude and variety of materials that will be sold are shown by the following figures:

Lumber and Finished Articles.—100,000,000 feet of lumber, 1,000,000 square feet of sash, 4,000 doors, 1,250,000 square feet of skylight, 1,500,000 square feet of roofing, 500 staircases, metal and wood, and several hundred carloads of telegraph poles and fence posts.

Iron and Steel Articles.—50,000 feet 4-inch cast iron water pipe, 50,000 feet 6-inch cast iron water pipe, 10,000 feet cast iron water pipe larger than 6-inch up to 36-inch diameter, 500 carloads wrought iron and steel pipe, $500,000 worth copper and steel wire, including trolley wire; 10,000 feet iron fence, 8,000 tons rods, bolts, washers, etc; 6,000 tons 60-pound steel rails, 2,000 tons lighter sections and two 11-foot steel stacks.

Plumbing, Steam Fitting, Etc.—1,700 closets and lavatories, $500,000 worth 8, 10 and 12-inch gate valves, and thousands of filters and coolers.

Fire Apparatus.—The complete fire protection service of the fair will remain in operation under the ownership and control of the purchasers of the fair until such time as fire protection is no longer necessary, when the equipment will be placed on the market. This will probably be some time next summer. This equipment includes, among other things, 4 chemical hose wagons, 5 fire engines, 10 deluge sets, 100,000 feet hose, 1½ to 2 inches diameter, 100 revolving standpipes, automatic sprinkling system in two large buildings, 5,000 galvanized water buckets, and twelve 18 by 12 by 10-inch Worthington underwriters' pumps.

Electric Lighting Supplies.—One of the items that cost the Exposition Company the largest amount of money was the equipment of the lighting service. This throws on the market 100,000 electric lamps never used, 350,000 electric lamps used, 250,000 lamp receptacles, and millions of yards of lamp cord.

Machinery.—The list of machinery sold to the wreckers has not yet been tabulated, but it includes some of the boilers and engines used to furnish power for the fair, as well as 75 motors from 100 to 500 volts; 2 traveling cranes and a vast amount of hoists, tackle, blocks, chain, trucks, scales, safes, etc.; several electric passenger elevators, 6 road rollers, 15 sets of architects' and surveyors' instruments, 200 electrical turnstiles, 50 dump wagons and hand cars, 60 other vehicles, 500 lawn mowers, 500 wheelbarrows, and the like.

As a matter of curiosity it can be stated that the wreckers also have the problem of disposing of 5,000 flags, 2,000 feet of burlap, 2,000 army cots, 2,500 opera chairs, 25,000 kitchen chairs, 2,000 iron beds, mattresses and hospital equipment, 300,000 flower pots and the buildings and contents of the vast greenhouses at the fair grounds.

Of course the largest item on the list is that of lumber, and the company is rapidly installing saw mills, planing mills and other machinery for working up this lumber into merchantable shapes and sizes, including plans for converting into salable kindling wood of several million feet of lumber that will not be available for the lumber trade. The announcement that the cast iron pipe laid at the grounds is to be placed on the market will be received with suprise by many of our readers, as it was understood that at the time the sale was made to the exposition company it contained a provision prohibiting the sale of this pipe as scrap, the intention of the sellers being to avoid a repetition of the demoralization of the pipe market which followed the Worlds' Fair at Chicago.

The wreckers have gone about their herculean task in a systematic manner. Even before the fair opened they had in their possession lists of practically everything on the grounds, with the original purchase prices. These lists were made the basis of their bids and will be made the basis of their selling prices. The policing of the grounds after March 1 will be in the hands of the wrecking company, and very rigid supervisions will be exercised with the view of preventing incendiarism, which wrought such havoc at the World's Fair Chicago.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the New Brunswick (N. J.) Light, Heat and Power Company, no change was made in the executive management. The chief officers are: President, John C. Eisele; Treasurer, Nathaniel King; Secretary, Henry M. Barrett.

Mr. J. Alex. Mayers, writing from Sydney, Cape Breton, under date of the 16th inst., says, the Gas Machinery Company, of Cleveland, O., is under contract to replace, for the Dominion Iron and Steel Company, 2 home-made P. & A. tar extractors with 4 machines built on accurate lines.

Recent advices from Trenton, N. J, are to the effect that the Michigan Light Company has been incorporated. Its registered office is 243 Washington street, Jersey City, N. J., the agent in charge is Mr. Charles N. King, and the named capital stock is $2,250,000. The incorporators are: Messrs. Walter B. Mahany, Walter Thiele and Charles N. King. The Company is to construct and operate gas and electric plants and steam and electric railroads.

At the annual meeting of the shareholders in the Columbia (Pa.) Gas Company, the officers chosen were: Directors, M. S. Sherman, W. H. Shenberger, Wm. B. Given, H. M. North and Horace Detwiler; President, James A. Meyers; Secretary and Treasurer, Joseph Janson.

"A. V. S.," writing from Toronto, Can., under date of the 16th inst., says: "I failed to see in the Journal any mention of a recent clever act done by the Consumers Gas Company, of this city. Several of its employees have been in its service for many years and are still on its payroll, doing some active work. The Company has determined to pension at least 14 of them, and hereafter while they live the weekly

payment of $3.50 will be made to them without any return in the latter line."

THE regular quarterly dividend of 2 per cent. on the capital stock of the United Gas Improvement Company has been declared. It is, as our advertising columns show, payable the 14th prox.

AT a recent meeting of the Board of Estimate and Apportionment of this city the following was adopted:

"*Resolved*, That the Corporation Counsel be requested to furnish to this Board as promptly as possible his opinion whether there is power in this city under its present charter to construct and maintain a plant for furnishing electric lighting to the public buildings and streets of the city."

MR. TOWNSEND SCOTT has resigned as a Director in and Chairman of the Finance Committee of the Baltimore Consolidated Gas Company. His successor is Mr. S. R. Bertron, of Bertron, Storrs & Griscom, of New York. The Board adopted resolutions complimenting Mr. Scott on the value of his services to the Company.

AT the annual meeting of the shareholders in the Waynesboro (Pa.) Gas Company the Directors elected were: Wm. H. Brown, Joseph Enniss, M. T. Brown, Charles W. Schaibley, John W. Clugston, E. Elden and William Middlekauff. Mr. Elden succeeds Mr. Jno. M. Wolff, who declined a re-election.

MR. AUGUSTUS HUESTON has been appointed Manager of the new business department of the Consolidated Gas Company, of New Jersey, with headquarters at Long Branch, N. J.

MR. PHILIP BALLINGER has been appointed Superintendent of the electrical division of the business of the Consolidated Gas Company, of New Jersey.

THE Directors of the Cincinnati Gas and Electric Company have declared the regular quarterly dividend of 1¼ per cent. From the current reports the Company looks to be earning pretty close to 7½ per cent. Good luck to the sensible, hard-headed, warm-hearted men who control its management.

ACCORDING to the annual report of Mr. George F. Moore, Superintendent of Street Lights for the city of Haverhill, Mass., for the year ended November 30, 1904, we find: "That the total number of street lamps in service at the end of the period named is 776, divided as follows: 199 electric arcs, 347 Welsbach naphthaline lamps, 227 Welsbach incandescent gas lamps and 3 incandescent electric lamps. Of the total number the Haverhill Electric Company furnishes the 3 incandescent lamps free, and the Welsbach Street Lighting Company, of America, furnishes the 2 gas lamps that illuminate the steps of the City Hall without charging therefor. All of the arc lights used for street lighting are furnished by the Haverhill Electric Company, which maintains all poles, lines and lamp fixtures. The arc lights are all 2,000-candle power; double lamps are run on 9.8 amperes of current at a pressure of 50 volts or 500 watts, an energy fully up to contract requirements. The street lighting committee, by authority from the City Council, contracted with the Haverhill Electric Company in October, 1903 (contract to take effect November 1, 1903), for 196 or more arc lights to burn every night in the year from dusk to daylight for a term of 3 years, thus doing away with the moon schedule, which has not been satisfactory to the citizens of Haverhill or the street lighting commi tee. The contract price is $102.50 per lamp per year. The Haverhill Electric Company, through its very able Superintendent, Mr. W. C. Corson, has done everything possible to give the city first-class service. Acting under the orders of the City Council, this department has installed one arc light during the year. The number of Welsbach gas lights in service November 30, 1904, is the same as at the last report, 225. These lights are burned on the moon schedule of 300 nights per year, and burn from dusk until 1 o'clock in the morning and are guaranteed to be not less than 60 candle power. The contract with the Welsbach Street Lighting Company, of America, which was renewed May 1, 1902, for a term of 5 years, stipulates that the Company shall furnish all lanterns, burners, fixtures and cross arms, shall pay for gas used, and make all renewals of glass, lamp fixtures, mantles, etc., the city to furnish the posts and riser pipes set in position, lighting, extinguishing, cleaning of lamps and labor for all repairs above the surface; and the city shall pay $18.50 per lamp per year in monthly installments. All of the contract requirements have been faithfully observed, and the service from these lights has been perfectly satisfactory."

THE necessary certificate has been filed with the Secretary of State announcing that the Directors of the Norwich (N. Y.) Gas and Electric Company will number 7 instead of 4. Mr. S. N. Blake is an added one.

A CORRESPONDENT in Toronto, Can., writing under date of the 15th inst., says that earlier in the month Mr. W. J. Christie, Chairman of the Fire and Light Committee, of Owen Sound, Can., announced that the price of gas would be reduced forthwith from $2, less 20 per cent. discount, to $1.50, less 10 per cent. for prompt payment. This is the first reduction made since the town acquired the plant two years ago, and it may be truthfully said that under the prevailing way of doing things the people are now better served than they were in the old days. Possibly so, and more than likely so; but the town originally had not nerve or confidence enough to supply light to its residents, whereas ordinary capital took the chance.

THE project for a gas plant at Paulsboro, N. J., is still in the air.

A PINTSCH gas outfit on a large scale is promised for Toronto, Can., next year.

A CORRESPONDENT in Hudson, N. Y., writing under recent date, incloses the following taken from the Poughkeepsie (N. Y.) *News Press:* "The suit of Messrs. Edward M. Atwater and Wm. H. Young against the Poughkeepsie Light, Heat and Power Company, which has been pending before Stephen G. Guernsey as referee for the past year, has been decided by the referee, who awarded judgment to the plaintiffs in the sum of $3,894.58. The case grew out of the absorption of the Poughkeepsie Gas Company by the Light, Heat and Power Company. It seems that when Mr. Atwater and Mr. Young, who had conducted the Gas Company as lessees for over 10 years, sold out to the new Company, there were several items about which those concerned could not agree. The largest item was $2,400 which the plaintiffs claimed for gas they had manufactured, and which was in storage and consumers' accounts when the new Company took hold of the plant. The lessees thought they were entitled to the amount from the meters up to November 1st of the year they turned the business over and to the few days in December to the time the meter takers had made account of the meters. In all it amounted to $2,400. This the new Company disputed. Another interesting claim was about a canal boat load of coal. It seems that a few days before the trade which put Messrs. Young and Atwater out of the gas business, Superintendent Hadden said he needed coal and hence ordered a boat load. It did not arrive until just as the new Company went into effect. The Company claimed that Messrs. Atwater and Young had ordered the coal, while the other two claimed that the Company had used the coal and were thus responsible for its payment. The suit was a friendly one, and Mr. Allison Butts, representing Messrs. Atwater and Young secured the appointment of a referee. The court appointed Stephen G. Guernsey, and before Mr. Guernsey many hearings were held. His report which has been filed with the county clerk is in the form of a final settlement. There were a few other small matters of contention, but the referee has settled everything satisfactorily by awarding the plaintiffs the judgment of $3,804.58."

MR. GEORGE BROOKS, through his purchase of the shares owned by Mr. Gotfried Falkenstein in the Cooperstown (N.Y.) Gas Light Company, has secured control of the property. Let us hope he will improve it.

MESSRS. W. J. HAYES, of Cleveland, O., and E. C. Lindsay, of Ravenna, O., have, it is said, secured control of the gas plant at Clyde, N. Y. They propose to enlarge the plant, both as to its generating and distributing divisions, each of which would respond readily to bettering.

WE understand that Mr. Coffin is about through with his work in connection with the rehabilitation of the plant at Watertown, N. Y.

THE most disappointed reformers in the gas line, in New York State, at least at the present time, are those who declared that the gas being supplied to the residents of Rochester, N. Y., by the proprietors of the Rochester Gas and Electric Company, was not up to statutory requirements. The objectors caused the purchase of the necessary testing apparatus, had it set up and manned on public account by trusted local professors, with the result that the "trusted" ones reported a candle value something like 10 per cent. over the prescribed one.

IT is understood that Mr. C. H. Dunbar, formerly in charge of the American Gas Company's plant at Elgin, Ills., which property was recently purchased by Col. Copley and his associates, will retire from active business.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

MONDAY, DECEMBER 26, 1904.

The Market for Gas Securities.

The Hearst tactics, aided in a very queer sort of way that proclaimed no protection whatever for the stock, put Consolidated gas well on the down slide during the week, the stock breaking well on to 10 points maximum. The closing to-day (Friday) was made at 196¼ to 196¾, quite a recovery from the low point of the week, but many, many points below even its extreme speculative value. The talk about a cut in the rate through Legislative enactment is ridiculous, unless those who would put such movement through will also decree that a revision of the law in respect of candle power shall also be presented.

Brooklyn Union is quoted at 203 to 210. Think of it, investors! A 10 per cent. stock in an industrial, the works of which are located in points where even Mr. Lawson's office boys can look them over every day. Talk of asinine investors! Let them to "the friend of everybody" go and be misled. The general gas share market is strong, especially in respect of bonded issues.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 26.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	195¾	19 3/4
Central Union, Bonds, 5's	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Mutual	3,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.— Bonds, 5's	11,000,000	1,000	112	113¼
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	.	..
Northern Union, Bonds, 5's	1,250,000	1,000	104	106
New York and East River— Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	108¾	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	999,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	203	210
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	—	—
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	5¾
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	107½	108
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89½
Preferred	3,026,500	100	107½	109
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	84	85
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	351,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	104½	105½
" Bonds, 5's	10,500,000	..	107	108
Indianapolis	2,000,000	..	70	75
" Bonds, 6's	2,650,000	..	106½	108
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	..
Preferred	2,500,000	100	90	..
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	106	106½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87¾	90
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	94	96
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	.
Washington, D. C	2,600,000	20	315	317½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del.	600,000	50	230	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Dec. 14, 1904.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 14th, 1905, to stockholders of record at the close of business, Dec. 31, 1904. Checks will be mailed.

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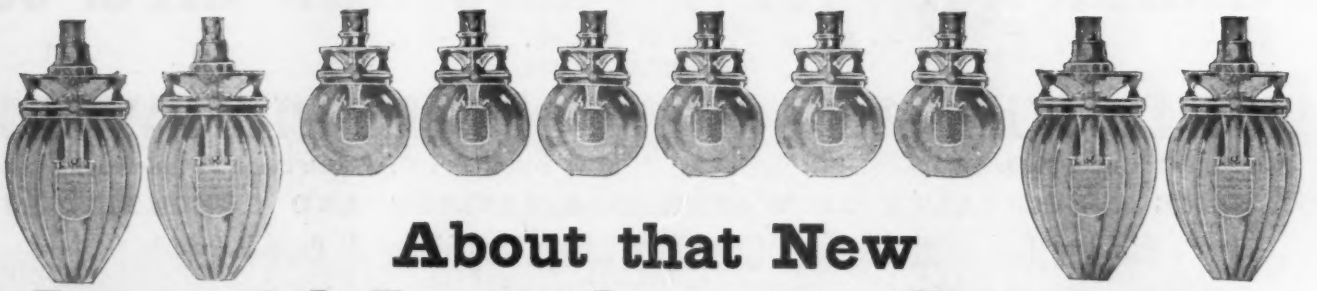

About that New Inverted Incandescent Gas Lamp.

CATCH ON AND GO AHEAD!

We are talking now to the Gas Man who didn't hear us at first. You must have failed to hear us altogether, for if you had caught just one of our points we would know you by name now--would be business friends, in fact.

We are glad that our first talk had such beneficial effects. Mutually beneficial they were, surprisingly so to us, and, we predict, surprisingly so to the man who caught on.

To every gas man who has not become our customer we have to say: "You cannot afford to wait longer. Don't be a trailer. Catch on."

Do you know that gas men in England are using over 15,000 INVERTED INCANDESCENT GAS LAMPS per month? They are selling gas, too, more than in a long time. It's just a beginning for both of us, but we're going up with a rush. It's starting in America just the same.

The consumer takes these lamps in a hurry, just as soon as he hears of them. He has had experience, poor fellow, and he knows. The points of superiority of our Inverted Incandescent Gas Lamp are so nearly what he would invent himself, if he could, that he wants to try them, and one trial convinces him absolutely.

THEY ARE SHADOWLESS--that is to say, they throw the shadow where it belongs, on the ceiling.

THEY GIVE A BETTER LIGHT.--We cannot emphasize too strongly this particular point. The light is brilliant, but soft; clear and white, but agreeable and soothing to the eye. They do not give that *ghastly* appearance to people and things so noticeable when the ordinary incandescent gas lamp is used. Their light is nearer to Sunlight than any light ever produced. A trial proves this.

EASY TO PUT ON.--This attracts the consumer at once. He wants a mantle, too, that goes on and arranges itself; not one that requires eternal readjustment and taking off to be tinkered. This lamp requires no further attention. The mantles are woven with closed ends.

DECORATIVE.--The lamp is particularly adapted to handsome cluster work. It offers, in fact, all the artistic and decorative effects that can be obtained from incandescent electrics. This hits the consumer, especially the large consumer who wants maximum effect at minimum cost. He wanted to use gas, but he wanted more the artistic electric fixtures, so he turned you down for the electric light man.

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Do you catch it? It's this: The Inverted Incandescent Gas Lamp offers you the means to successfully compete with the electric light people. Before, you had only the argument of economy. We have given you all the others necessary. Our lamp is better and cheaper. That settles it!

Don't you think we had best get togother--you and the consumer and ourselves? He wants a superior light. You give him the gas, and we supply the lamp that makes him satisfied.

Along these lines we have some special inducements to offer. They are confidential pointers and will interest you. Send us your name and address to-day. We have also more detailed information to offer and a complete price list.

How about an exhibit in your offices and show rooms for your patrons? We had one at the Fair. Perhaps you saw it We know that it interested gas men, for they told us so in person, many of them. We can interest you about that exhibit. Don't forget it. Write to-day.

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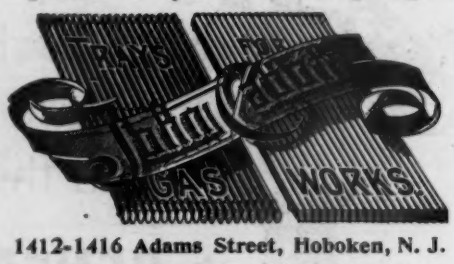

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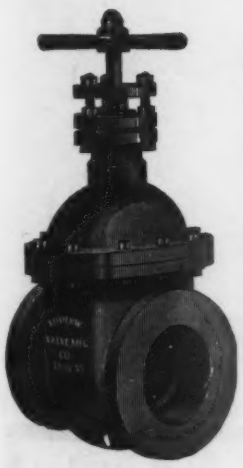

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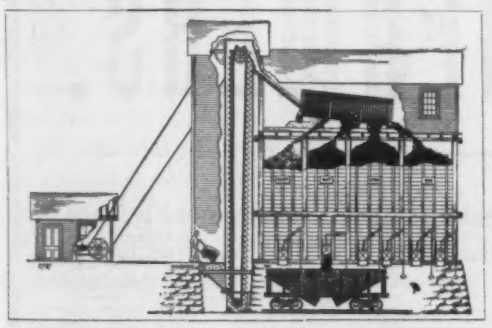

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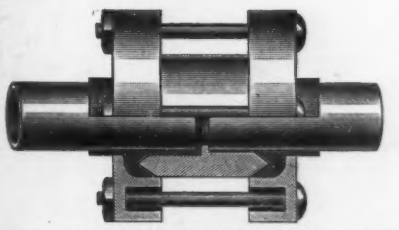
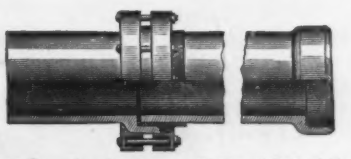
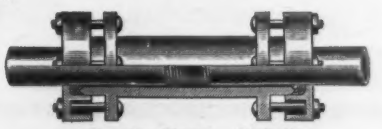


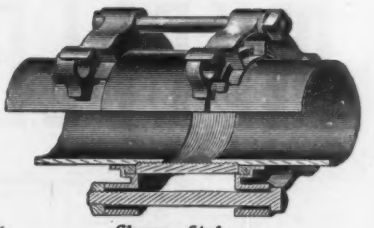
Insulating Coupling for Wrought Iron Pipe. Style 5.



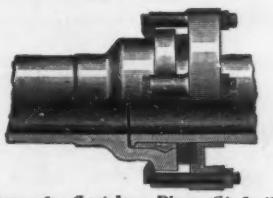
Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.



Regular Sleeve. Style 2.



Clamp. Style 4.



Clamps for Cast Iron Pipe. Style 4½.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

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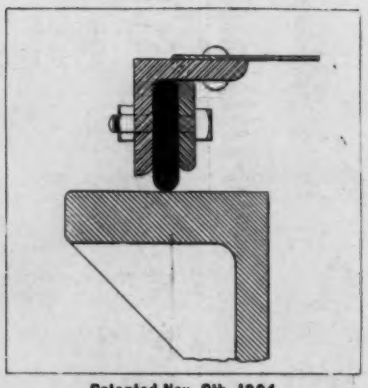
WHAT PRESSURE DO YOU CARRY AT THE BURNERS?

Let us know this and we will send you samples of the right burner for your pressure. We make Steward Burners checked for 8-10, 12-10, 15-10, 20-10, 25-10 or 30-10, and in sizes from 2-foot to 8-foot.

D. M. STEWARD MFG. CO., Est. 1876, CHATTANOOGA, TENN., U. S. A.

Hence

In Lloyd's Rubber Lute



Patented Nov. 8th, 1904.

the method of holding the rubber leaves the contact edge **entirely free and uniformly elastic for sealing, and**

LLOYD CONSTRUCTION CO.,
DETROIT, MICH.

Hither

MUELLER PIPE REAMERS.

RATCHET HANDLE PATTERN.

C—035.

While it requires steel of good quality to make good reamer blades, it also requires good tempering to utilize the quality of the steel.

Mueller Pipe Reamer Blades are made of steel of good quality, and tempered in a manner to make the best use of its quality in the strength of the blade and the durability of its edge.

Mueller Pipe Reamers will ream any size of pipe, from ⅜ to 3-inch. They are made in plain handle and ratchet handle patterns. The reamer illustrated is the ratchet handle pattern.

Each reamer is carefully inspected and assembled, is given a test as near like actual service use as possible, bears the Mueller trade mark, and is *unconditionally guaranteed.*

We also make gas cocks, tapping machines and meter connections for gas works' use. Catalogues upon application.

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Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

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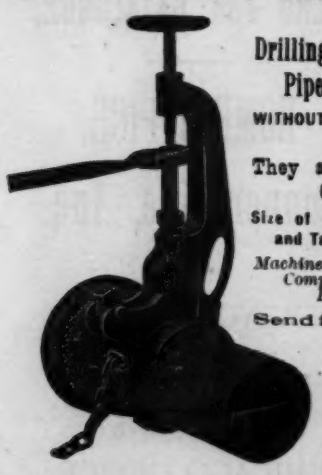

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Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

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Temporarily during alterations and repairs. : : : :

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STATIONARY, SHAKING, DUMPING.

BARS FOR HAZELTON BOILERS.

BELT CONVEYORS

EQUIPPED WITH

BALL BEARING ROLLS

ARE THE BEST,

because they possess greater efficiency, consume less power, and the belts last longer than when any other type of roll is employed.

PLANS AND ESTIMATES FURNISHED ON REQUEST.

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PHILADELPHIA,
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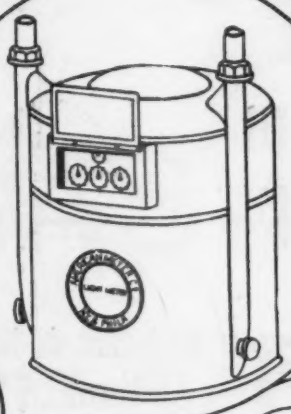
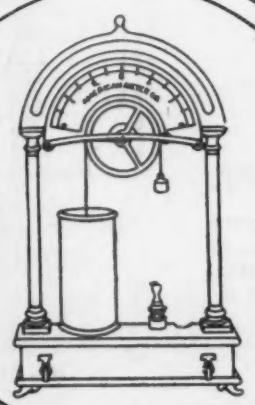
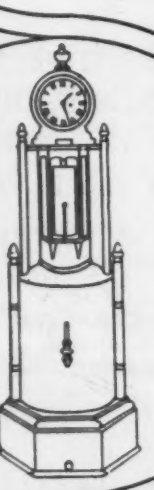






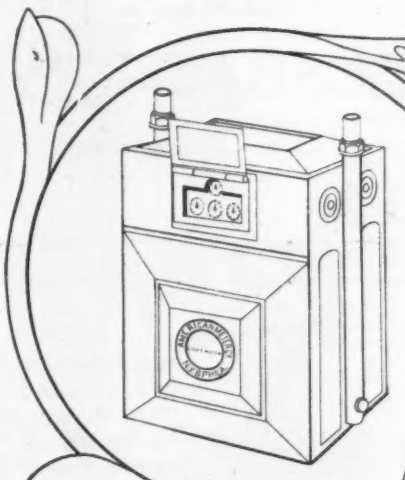
PUBLIC LIGHTING TABLE.

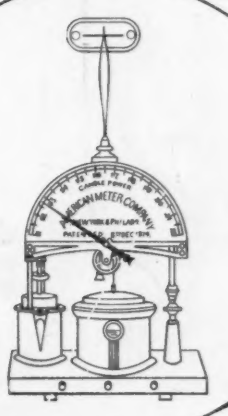
JANUARY, 1905

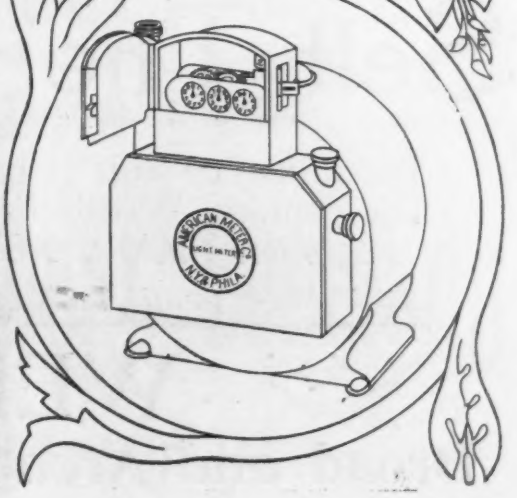
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	5.20 PM	5.00 AM	4.30	6.30
Mon.	2	5.20	6.20	4.30	6.30
Tue.	3	5.20	6.20	4.30	6.30
Wed.	4	5.20	6.20	4.30	6.30
Thu.	5	5.20 NM	6.20	4.30	6.30
Fri.	6	5.20	6.20	4.30	6.30
Sat.	7	5.20	6.20	4.30	6.30
Sun.	8	5.20	6.20	4.40	6.30
Mon.	9	5.20	6.20	4.40	6.30
Tue.	10	8.50	6.20	4.40	6.30
Wed.	11	9.50	6.20	4.40	6.30
Thu.	12	10.40	6.20	4.40	6.30
Fri.	13	11.40 FQ	6.20	4.40	6.30
Sat.	14	12.40 AM	6.20	4.40	6.30
Sun	15	1 40	6.20	4.50	6.25
Mon.	16	2.30	6.20	4.50	6.25
Tue.	17	3.30	6.20	4.50	6.25
Wed.	18	4.30	6.20	4.50	6.25
Thu.	19	No L.	No L.	4.50	6.25
Fri.	20	No L. FM	No L.	4.50	6.25
Sat.	21	No L.	No L.	4.50	6.25
Sun.	22	5.40 PM	8.00 PM	5.00	6.25
Mon.	23	5.40	9.10	5.00	6.25
Tue.	24	5.40	10.20	5.00	6.25
Wed.	25	5.40	11.30	5.00	6.25
Thu.	26	5.40	12.40 AM	5.00	6.25
Fri.	27	5.40 LQ	1.50	5.00	6.25
Sat.	28	5.40	2.50	5.00	6.25
Sun.	29	5.50	3.50	5.05	6.15
Mon.	30	5.50	4.50	5.05	6.15
Tue.	31	5.50	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1905.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	240.50	January	423.20
February	192.20	February	355.25
March	207.00	March	355.35
April	175.10	April	298.50
May	161.00	May	264.50
June	139.50	June	234.25
July	149.00	July	243.45
August	161.50	August	280 25
September	173.00	September	321.15
October	205.00	October	374.30
November	211.00	November	401.40
December	229.00	December	433.45
Total, yr.	2245.00	Total, yr.	3987.45



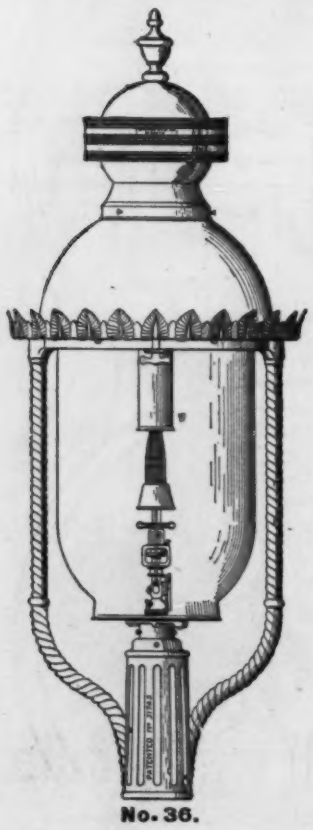




NEW YORK, 97 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple---

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

WELSBACH CO.,

Broad and Arch Sts., PHILADELPHIA.

THE UNITED GAS IMPROVEMENT COMPANY

For the Period Ending July 31st, 1904, has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

Augusta, Me.
Bangor, Pa.
Woonsocket, R. I. (2d contract).
Brooklyn, N. Y. (4th contract).
Cincinnati, O. (2d contract).
Scranton, Pa. (3d contract).
New York City (14th contract).
New Haven Conn. (2d contract).
Watertown, N. Y.
Tampa, Fla. (3d contract).
Westchester, N. Y. (3d contract).
Bridgeport, Conn. (2d contract).
St. Paul, Minn. (2d contract).
Harrisburg, Pa.
Pelham, N. Y.
Reading, Pa.
Springfield, Mass. (2d contract).
Lynn, Mass. (5th contract).

TOTAL SETS, 1904, ... 35
TOTAL DAILY CAPACITY, 1904, . . 50,400,000 cubic feet.
TOTAL SETS TO DATE, ... 543
TOTAL DAILY CAPACITY, . . . 413,180,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

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CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
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MANUFACTURERS OF

CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

Established 1854. Incorporated 1869.

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Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
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Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office: Cor. Manchester and Sulphur Avenues, St. Louis, Mo.

Established 1845. Reorganized 1902.

The Kreischer Brick Mfg. Co.,

Manufacturers of the very best quality of Clay Retorts, Blocks, Tiles, Settings and Firebrick of every description.

Also Miners and Shippers of Fireclay, Fire Sand, Ground Brick in Barrels.

WORKS: KREISCHERVILLE, STATEN ISLAND.
OFFICE: 119 E. 23D STREET, NEW YORK CITY.

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GENERAL OFFICES: Park Row Bldg., N. Y. City.
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WORKS: Weber, N. J.

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Modern Coal Gas Plants,

With either Horizontal, Inclined or Vertical Retorts.

PATENTS APPLIED FOR.

No. 1. Firing horizontal benches with pulverized fuel, with either 8 or 10 retorts in 1 setting, using one furnace for two benches. Great saving in labor, fuel and life of retorts and settings. No elaboration of complex recuperation.

No. 2. Independent retort settings, taking all weight from retorts.

No. 3. Vertical retorts with vertical charge and discharge. Sixteen retorts in one bench.

MODERN BENCH IRONWORK.

ISAAC C. BAXTER, President.
Works, LOCKPORT STATION, PA.

ESTABLISHED 1864.

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Successor to WILLIAM GARDNER & SON.

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Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. BLOOMINGTON, INDIANA.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

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For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

Bristol's Recording
PRESSURE GAUGE.

For continuous records of Street Gas Pressure.

Simple in construction, accurate in operation and low in price.

Fully Guaranteed. Send for Circulars.

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Waterbury, Conn.

Silver Medal, Paris Exposition

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE.

Plans prepared and Estimates furnished at short notice.

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RETORT & FIRE BRICK CO.

MANUFACTORY AT
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Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

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Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

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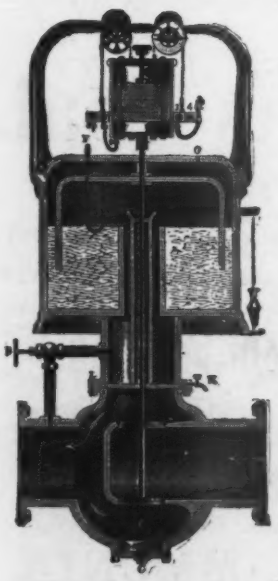

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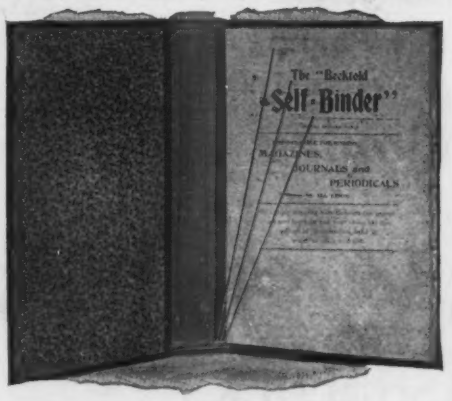

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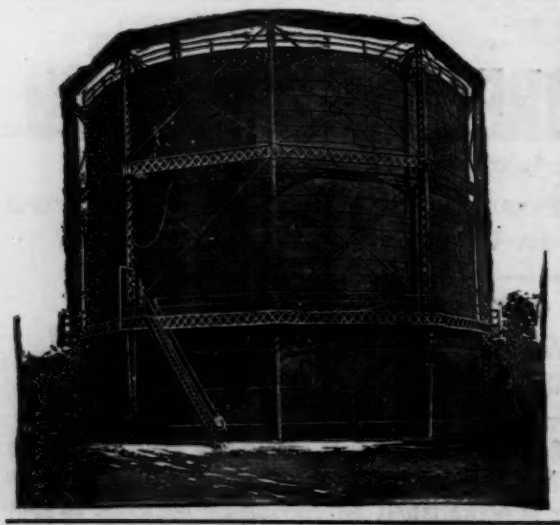

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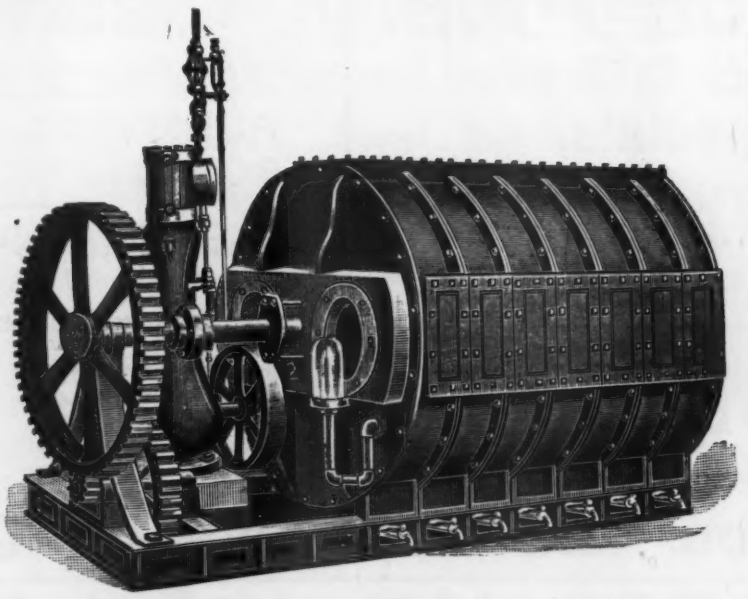

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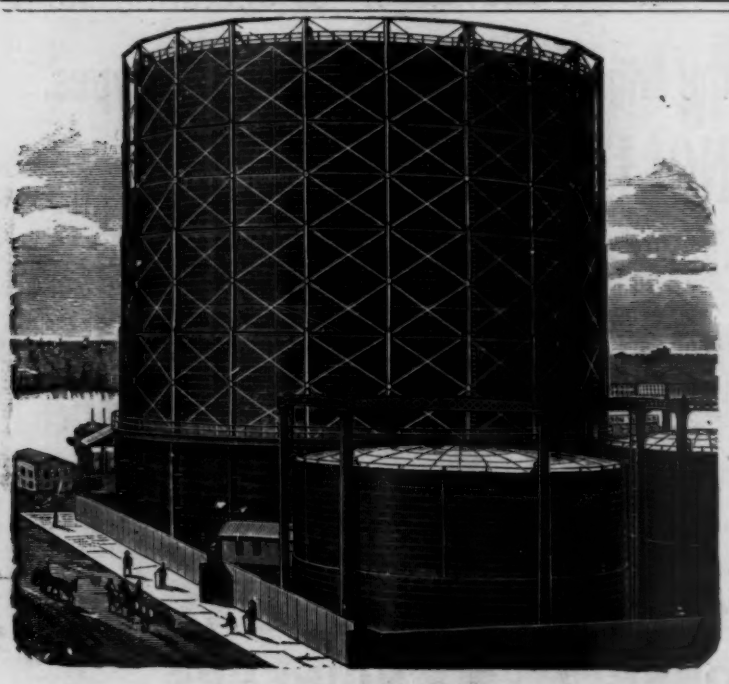

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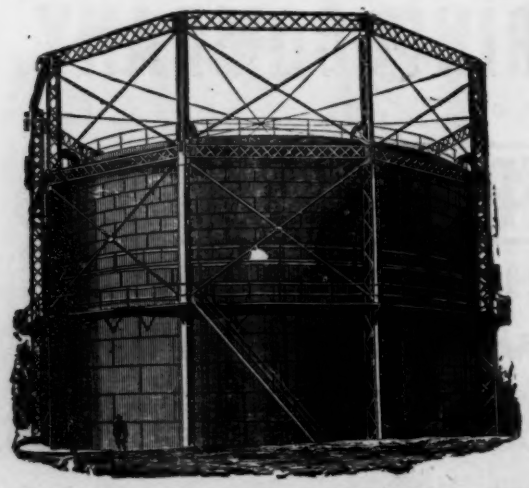

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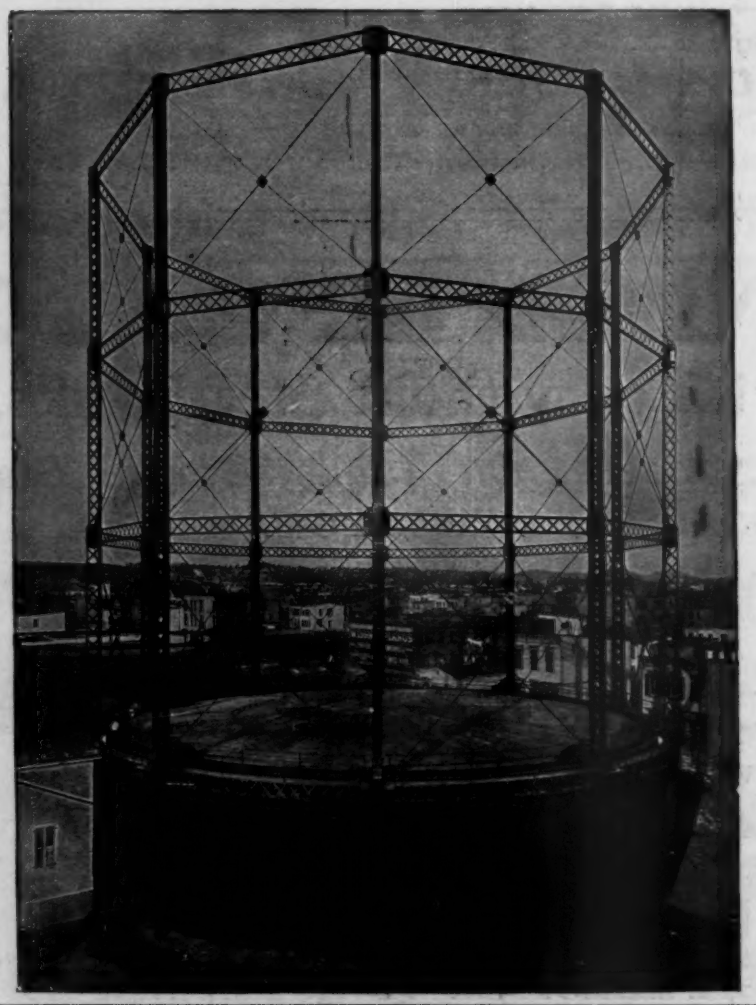

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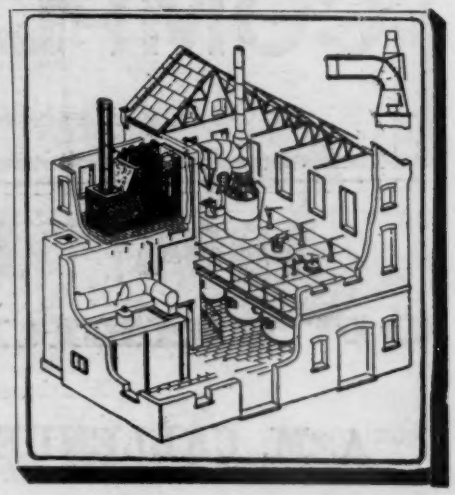

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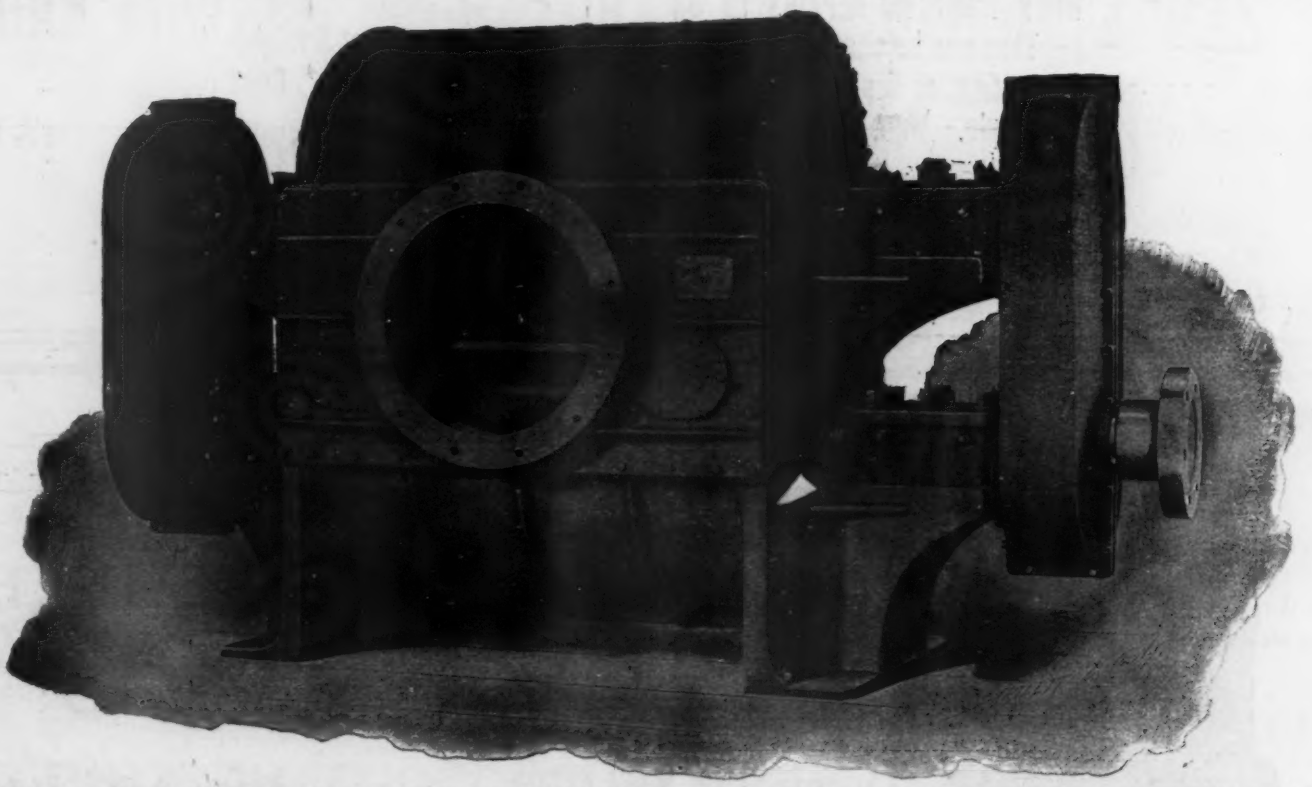

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